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Managing the Gradual Transition from Paper to Electronic Patient Record (EPR)

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Cand Scient Thesis

30th April 2004

To my father and mother

Abstract

This thesis is drawn from an ongoing, large-scale project of implementing Electronic Patient Record (EPR) at Rikshospitalet, which is the national hospital in Norway. The fact that the notion of the electronic record dates back to the 60's and 70's, illustrate how highly challenging the transformation to digital record has been. The overall aim in this study is to develop a deeper understanding of the socio-technical aspects of the complexities and challenges emerging from the implementation of the electronic patient record, and in particular to study how to manage a gradual transition to digital patient record. The analytical framework that was used in this thesis is constituted of Actor Network Theory (ANT) which I will use as a methodological theory to view Information Infrastructures (IIs). This will provide a framework for the socio-technical aspects and cover processes that are accumulated in the implementation, use and change of a new technology. In addition, I used theoretical concepts from studies undertaken within the Computer-Supported Cooperative Work (CSCW). This research is framed by qualitative research methods following an ethnographic approach. By applying a combination of several techniques I collected and generated the empirical data. The fieldwork in this study was conducted over three phases, and lasted over a period of one year. Most of the fieldwork was conducted in two departments, the neurology and neurosurgery department. The thesis includes four cases, where the first one describes the development and implementation process of the EPR in the two departments. Thereafter, a case study of a Parkinson patient is presented. The transition to internal electronic referral letters is described as the third case, and finally, an introduction of the scanning project is provided. Subsequently, all these cases are analyzed by holding infrastructural focus together with a work practice orientation. Drawing upon the analysis, I discuss the implications of the empirical cases and the analyses for theory. I view the transition process as a mutual, dynamic, and reflexive transformation of both information infrastructures and situated practices of use. The study shows us how implementing an electronic record changes not only one element in this interplay between the paper-based and the electronic record, but also the work practices that were developed around it. In addition, I will illustrate how the medical record and the work practice are not singular elements, but rather part of a large heterogeneous socio-technical network that includes artefacts, tools, people etc. By applying an infrastructural orientation, I focus on the heritage of the installed base as well as the need for strategies to manage gradual transitions, such as cultivating the installed base and developing gateways which can link various components. By merging this perspective together with a work practice orientation, I illustrate how the transition process to an EPR is not merely a transformation of information infrastructure, but also of situated work practices. I explore how the heterogeneous actors, the complex medical practice, and the various artefacts are interlinked and aligned to each other, and illustrate how a transformation of one of these components will affect the socio-technical infrastructure. This again sheds a light on the importance of finding a way to conduct changes while avoiding breakdown in the whole chain of work. In addition to cultivation and the use of gateways, a gradual transition can be conducted by identifying borderline issues. Beside the theoretical implications, the case of the EPR provides an opportunity to study the issues of scaling large information infrastructure, and thereby provide an empirical contribution to studies within the Information System (IS) field. Finally, I reflect upon several practical implications for organization of change in such a large and complex healthcare organization.

Acknowledgments

This thesis is submitted to the Department of Informatics at the University of Oslo as part of a candidates scientiarum (cand. scient.) degree.

I wish to express my sincere gratitude to the following individuals for their support and guidance in this project.

First of all, I would like to express my sincere gratitude to my supervisor, Margunn Aanestad for all the help, patience and positive and constructive comments throughout the work on this thesis. Your encouragement, guidance, enthusiasm and dedication have been an important source of inspiration! Without your contribution and collaboration, this thesis would not have been possible.

I would like to thank the EPR research group, at the Department of Informatics for the intellectual and stimulating discussion. I am particularly grateful to Miria Grisot for her valuable and constructive comments about my work-in-progress. I am deeply grateful to Judith Gregory for her support during the final period of writing, and for correcting my English.

This research would not have been possible without , Ivar Berge who had been an important contact person and assisted me with establishing contact with the healthcare personnel. I would also like to thank healthcare personnel at the Neurology department and Neurosurgery department, who let me observe their work and were very helpful in explaining everything. I hope that the finding form this research can be useful for Rikshospitalet, which is on the threshold of great challenges.

Finally, I would like to thank my friend Irene for her technical support. Many thanks to my uncle Mazen, and my cousins Samir and Rami for their patience and support. A big warm thank goes to my aunt Kari, who supported me tremendously throughout the work one this thesis. Don't know what I would have done without you!

Most of all, I would like to thank my mother Maya, my brother Toofik and my sister Georgina, for always believing in me. Thanks you for your love and support!

Nina Boulus
Blindern, 30 April 2004

Contents

1. Introduction

1. 1 – What is an EPR?

An Electronic Patient Record (EPR) is an electronic medium for storing clinical information. Most of the electronic patient records replicate the structure that is used in the paper-based record, and it accumulates all the information that is relevant for the treatment and nursing of a patient. Among others, the record includes physicians' notes and nurses' notes concerning the ongoing treatment. The electronic patient record includes both clinical information: such as diagnoses, allergies, and medicines; and demographic information, such as: personal information, for non-clinical use. It contains information that is used in diverse areas for different purposes. Physicians, for instance, use the EPR for diagnostic and therapeutic decisions. Other users of the EPR are public authorities from national and county level, or the hospital's management, who use extracted date for statistics and planning. In other cases, the medical record is used for generating research information; it may be used by insurance companies (in Norway), and so forth.

The particular EPR system that I studied is basically a text-editor, which supports documentation of various types of notes, in addition to a module for prescriptions and sick leave form[1]. The writing editor that is used for the EPR system is Microsoft Word. There are several prospective propositions for functionalities that can be added to the EPR system. One of the proposal projects is to integrate the EPR system with other existing specialist systems, for instance, a range of diagnostic images such as ECG, roentgen pictures, and computer-tomographic images. As the system is built today, the EPR is partly integrated with PiMS (Patient Information Management System), which is the Patient Administrative System (PAS[2]) that is used in the hospital. This integration provides the possibility to retrieve certain information from PiMS into the EPR system, but the synchronization process does not work the other way around.

1. 2 – Visions and Challenges of EPRs

An Electronic Patient Record (EPR) is expected to allow significant improvements to the medical work practice. It is not my intention to mention them all, but rather to mention the essential ones. Replacing paper-based records with EPRs will radically enhance the way information is gathered, stored, distributed, and used. This implies increased obtainability (availability) and accessibility of the whole record. The medical personnel

[1] The Sick form (sykemelding): notes from the doctor giving a person time off work due to illness.
[2] Patient Administrative System (PAS) contains basic demographic information (name, date of birth, addresses, etc.) and support for budgeting, accounting, resource allocation, and for planning waiting lists, appointments and patients' visits and stays. The EPR system imports information from PiMS, which imports information from the register office (Folkeregister).

do not need to waste a long time in trying to trace the paper record in the whole hospital since it is continuously available in the electronic format. The electronic patient record opens up new opportunities when it allows several people to read the same record simultaneously from different computers, and to retrieve the most updated information. In other words, the electronic record is expected to allow increased consistency and decreased redundancy of information. In addition, a better organisation and structure standardized presentation is acquired to the patient record since the system saves automatically the document in the correct chapter. Digital documentation has a better quality than papers, and it is a safer medium for saving information since a backup copy is being taken everyday. Lastly, using an electronic medium sustains and reinforces control mechanism for the medical record since one can see all the logs of the personnel, including in which records they have been looking, and the reason for retrieving information.

The idea of computerized patient record that contain clinical information as recorded in the medical record was introduced in the 1960's and 1970's (Collen, 1995). For the last thirty years, the development and implementation of Electronic Patient Records (EPRs) has been seen as a highly challenging task. Among prevailing visions of what EPRs should be, are goals to make these management tools that will be able to support managed care logic, redesign of work processes, and improved quality of care (Nilsson, Grisot and Aanestad, 2002). Electronic patient records are expected to increase efficiency, coordination and planning, and consequently, decrease waiting times for patients and costs. "The grand visions of the benefits of EPRs expect it not to just replace the old-fashioned, messy and inadequate paper records, but to fundamentally transform and improve medical care" (Dick and Steen, 1991 in Nilsson et al., 2002, p. 2). However, the transition to electronic patient records has turned out to be an unexpectedly long and complex process where many goals have not yet been met. According to a Norwegian survey conducted by Ellingsen, Lærum and Faxvaag (2001), it has been shown that the use of EPRs is fragmentary and inefficient compared to the potential (Lærum, Ellingsen and Faxvaag, 2001). Even though most of the hospitals in Norway (77%) have already implemented an EPR of some kind, the use of the EPR is still sub-optimal. So far, the electronic records did not convey dramatic changes within organisation or effectiveness. "Despite a series of heavily funded national and international initiatives, there is only very modest success in establishing working EPRs in large hospitals" (Ellingsen and Monteiro, 2000 p. 119). Based on my empirical data from two departments in one hospital, most of the doctors used the EPR system first and foremost to read patient information, while few of them used additional functions for electronic prescriptions or sick leave notes. The system has gradually been made available in all the departments in the hospital, and changes within simple information handling and actions can be found. However, the overall routines around patient information handling and the work process are approximately as before. In summary, we can see here how the original ambitions and visions of the EPRs were very high, and how long and complex the process turned to be. This complexity and the decrease in the expectations is the source for my research motivation.

It is obvious that changing such a large and complex infrastructure as the electronic record takes time, and requires extensive supporting layers. There are many technological issues that need to be configured before the implementation of the electronic records will

be complete. Among others, a complete digital system that will accumulate all the information in digital form must exist, and the electronic record must be integrated with other local systems (both clinical and administrative). In the meantime, we are in an intermediate phase, where both paper and electronic records are being used simultaneously. The transition process to an electronic patient record can be unexpectedly long, and the vision for an electronic record might be realized in the long term. Therefore, it is paramount to study not only the development of this technology, but also to acquire a better understanding of the socio-technical processes that are involved in the implementation, use and change.

1. 3 – History of the Medakis Project

Rikshospitalet is one of the members of the Medakis project, which is a large-scale project promoted by the Ministry of Social Affairs. This is a national project that involves the five university hospitals, which are the largest hospitals in Norway. The main idea behind this project was to establish one common solution for Clinical Information System (CIS), and establishing Electronic Patient Records (EPRs). In 1996, the five regional hospitals signed on a contract with Siemens that was chosen to be the vendor for implementing the EPR System (dubbed DocuLiveEPR). Requirements specification was worked out in collaboration between Siemens and the hospitals. The aim was having one common system that would obtain faster and better access to the information in patient records, in addition to contributing to an improvement in productivity and quality of the information. According to Ellingsen and Monteiro "a key concern in the Medakis project has been the role of DocuLiveEPR in relation to the rich variety of other information systems, in other words, the strategy of integration" (Ellingsen and Monteiro, 2000, p. 123). DocuLive EPR was assumed to function as the core information systems as well as provide a common platform for Electronic Record Systems (EPRs) that includes numerous integrated modules supporting various activities in an organisation.

DocuLive EPR has been a local system developed in Norway, in 1995. This implies that its architecture is considered old. Siemens, which has been implementing EPR systems to the UK, Sweden, Norway and India, decided to go for a "global" product within the health market. The different systems such as, Melior (Swedish) and DocuLive (Norwegian), were merged into one global system, called ComEPR (Common EPR). This product never went into production, but this can be looked upon as a middle step between DocuLive EPR and the next global product, which is Soarian Clinicals. Soarian has a different user interface and a totally different architecture from DocuLive EPR. At this stage, it is difficult to say anything about the new EPR system, and whether Rikshospitalet and the other regional hospitals will decide to install the new product or rather choose particular modules from the product. There are various ongoing projects, but it is yet too early to anticipate the future of EPRs systems.

As from the initial plan of the Medakis project, the final product (v 5.0) was supposed to be delivered in December 1999. In the beginning of 2004, the project was terminated without fulfilling completely the initial goals. Instead, each regional hospital signed on individual contracts with Siemens Norway. In summary, reconstructing the history sheds

a light on the complexity that is implied in the implementation process of the EPR, and of the various challenges that it constitutes.

1. 4 –The Increasing Focus on EPRs

There are, of course, many reasons for this intensified interest in EPRs. One of the main reasons is that EPRs are seen as solutions for various problems faced in the health care organisation. The health sector has been undergoing many changes due to the increased demand for efficiency and quality, and a transformation from having a "public sector" culture to a "business" culture. This has emerged as a general shift from quality of service to increased focus on costs saving and documenting activities, efficient use of resources and benefits.
Rikshospitalet was owned and financed by the Norwegian state. This situation has changed due to major hospital reform that was initiated in 2002. Prior to the health reform, most hospitals were owned and managed by the county where they were located, while now the hospitals are managed by five regional health enterprises. Below each regional health enterprise, there are many individual hospitals where each one of them is organised as an enterprise. This reorganisation of the ownership and management structure was motivated by the need to increase efficiency and quality of services, as well as reduced costs. The overall goal was to exploit existing resources within the various regions, implying increased collaboration and centralization of services. The new health reform altered the hospitals' functions and structure, and it also had an essential impact on IT strategies and topical implementations.

As a result, Rikshospitalet decided to be more involved and take an active role in the implementation of the EPR project, aiming to achieve accomplishments by means of financial and structural resources. This context shaped the changes in the strategy that was used in the IT department, and they now were forced to identify economic benefits from the transition to an electronic patient record. This raised the on-going discussion concerning the need to identify the so-called "Quick wins", which implies identifying the functions that can give an immediate payback and visible benefit. Traditionally, the EPR projects did not give an immediate payback that is visible in the budget, but rather showed results in terms of efficiency in the long-term. Finding visible benefits became a larger and a major challenge recently, especially due to the various political and economic changes (e.g. cutting off in the budgets) in Health Company South (Helse Sør region- south Norwegian region which Rikshospitalet is part of) and generally within the health sector in Norway. The EPR has been seen as crucial for achieving more effective processes, and therefore the IT department received complete support from the management of the hospital. Currently, the IT department has been focusing on process-analysis and activity-enhancement, in order to show how IT in general, can increase effectiveness of work processes.

The above mentioned introduced the overall context and external pressure that formed the initiatives to develop some kind of EPR system. However, there was also an internal pressure that emerged, and this refers to the increasing space-problem that was faced at the archive department in the hospital. When the electronic patient record was implemented, there were large expectations that this will help decrease the amount of

papers that were produced in the various departments. However (as will become evident later), this proved to be wrong and the volume of papers increased dramatically. According to Iacucci et al. (2003) "it has been evaluated that since 2001 the yearly growth of the 'active' archive[3] amounts to approximately 1200 shelf meters" and "more than 300 shelf meters of records are laying on the floor" (Iacucci, Grisot, Aanestad and Hanseth, 2003, p. 18). This growth in the physical size of the paper records is a direct consequence of the decision to centralize and merge the paper-based records (Iacucci et al., 2003). However, the growing physical size of the paper records was also due to other reasons, which one of them relates to the change in the medical practice. Recently, storing data became more important, and therefore more information is being registered. In addition, quality assurance becomes more paramount, and there has been an increase in the number of rules for what should be documented and how. Another possible reason for the increase in the number of records is that recently, there are more people that live longer. These changes in the archive have been going concurrently as the implementation of the EPR. In summary, the archive department was suffering from crisis, both in physical space, and in the increasing amount of workload (more than 30% of the requests could not be satisfied). This generated a pressure for making changes and migrating towards using digital medium for storing information.

1. 5 – Motivation for the Research

This thesis focuses on the transition from paper-based patient records to electronic patient records. The paper-based record forms the core of the medical practice in the sense that most services are built upon and based on the paper record. When looking at the history of the medical record, we can see that it had been developed through the last hundred years, and gradually, various routines for information handling have been developed to support the use of the paper record. Hence, the paper record and the routines around it are strongly interlinked to each other. This illustrates how important the socio-technical interplay is. The transition to electronic patient record is one of the most challenging and complex processes. Therefore, the aim of this thesis is to develop a deeper understanding of the complexities and challenges associated with such a transition process of the information infrastructure. This will be done through following the implementation process of the EPR.

My theoretical motivation for conducting the following research emerges from the fact that the case of the EPR provides an opportunity to study the issues of scaling large information infrastructures. As will be described in the theory chapter, information infrastructures grow and expand as time goes by, and accumulate pressure to make changes. Hence, infrastructure has to scale and evolve, to meet new requirements, and to support a growing population of users and new services. The problem is how to accomplish changes to the whole information infrastructure (Monteiro, 1998). Monteiro points out in his article: "Scaling information infrastructure: the case of next generation IP in Internet" that "This concern for facilitating an evolving, constantly changing infrastructure is not restricted to only Internet. It carries over to the National Information

[3] The active archive is one of the two sections in the archive department that contains recently opened or updated paper records. The other section in the archive department contains old records, called passive records, that are not frequently requested.

Infrastructure initiative as well" (Monteiro, 1998, p. 230). Changing an infrastructure should be a smooth *transition*, following an evolutionary approach. The transition is gradually implemented by continuously following incremental steps, and is determined by socio-technical negotiations. I will argue that IIS (Information Infrastructure Systems) theories focus primarily on technological aspects and the installed base, and it is therefore important to merge (combine) these theories together with a work practice orientation (situated practice of use) (e.g. Strauss, Fagerhaugh, Suczek and Wiener, 1985).

The thesis is organised as follows. Chapter 1 contains an introduction where I discuss the increasing focus on electronic patient records, and explain my motivation for conducting the research. In chapter 2, I provide theoretical framework for the study, including an introduction of Actor Network Theory, the information infrastructure perspective, and concepts from studies undertaken within Computer-Supported Cooperative Work (CSCW). Thereafter in chapter 3, I describe the historical background and the current status of the case, and the research focus. Chapter 4 illustrates the setting of the case, as well as the methodological approach used in the research. In chapter 5 the empirical evidence is presented, four cases. I will start by presenting the implementation process of the electronic patient record, and then, provide a case-study of a Parkinsons patient. Thereafter, I will present the implementation project of internal electronic referral letters, and briefly explore the scanning project. Chapter 6, includes the analysis of these cases in the light of the theoretical concepts. Subsequently, in chapter 7 includes a theoretical discussion of transition processes, as well as a reflection of the practical implications. Finally, the last chapter contains concluding remarks and last words.

2. Theory

In this chapter I will present the theories that I used as an analytical framework for my empirical material. I begin by introducing Actor Network Theory (ANT) which I will use as a methodological theory to view Information Infrastructures (IIs). This will provide a framework for the socio-technical aspects and cover processes that are involved in the implementation, use and change of a new technology. I choose to use the ANT as a "box of tools", meaning that I pick up some of the theoretical concepts to describe how, where and to what degree technology influences human behaviour (Monteiro, 2000). When using a network perspective to view artefacts, we take the artefacts into the social world, and try to understand their roles and meanings in work. This perspective sheds a light on how human and non-human elements are interwined, and together creates heterogeneous socio-technical network. Subsequently in chapter 2.2, I describe the Information Infrastructure (II) perspective, presenting the key concepts and illuminating the implications of using this perspective. Thereafter, I will outline strategies for conducting changes and managing a transition, and will shed light on the need for transition strategies. Finally, in chapter 2.3, I will introduce various theoretical concepts from studies undertaken within Computer-Supported Cooperative Work (CSCW). Following a work practice orientation, I will apply the concepts of trajectories and articulation work, accumulation and coordination, and borderline issues. This will provide us a deeper understanding of how technology is interlinked to its context. I will refer to these concepts as practice oriented, or action/work oriented.

The way I use the Information Infrastructure perspective describes issues on a general level. This includes the actors and activities (processes) in an infrastructure, but it does not describe *how* these actors and activities are interdependent and interrelated to each other. In other words, the information infrastructure perspective presents the installed base; the elements in the existing infrastructure. However, it does not describe the meaning and role of these elements. By using theoretical concepts from the CSCW field, I zoom in to a deeper level, focusing on work practices and unpacking micro-elements as artefacts down to their empirical constituents. Such work practice oriented studies following ethnographic methods, allow us to go between layers and analyse formal and informal aspects (Star, 2002). This is an important argument that will be addressed later in the discussion, in chapter 7. Aiming to draw a holistic and broader picture of the overall infrastructure, I use the II perspective along with work practice oriented concepts (sociological methodological concepts). This way, I acquire the possibility to zoom in and out of a situation as required, as well as flexibility to move up and down in the analysis.

2. 1 – Actor Network Theory (ANT)

Actor Network Theory (ANT) is one of the several theories that can be used for understanding Information Infrastructures (IIs). My motivation for using actor-network theory comes from the fact that this theory provides a framework for the socio-technical aspects, and views the technology as an actor on line with other actors. I find this theory

important as it provides theoretical concepts for documenting a complex and heterogeneous socio-technical work practice with many actors. In addition, I believe that it can help to illuminate how new technology affects and interacts with the various actors and vice versa (indicating a mutual interaction process). When using this theory, the natural and social constitute *heterogeneous actor-networks*. Actor Network Theory (ANT) views human and non-human as linked elements in the networks, and it focuses on the relations and interplay between these elements, rather than on each actor separately. Information Infrastructures (IIs) are large integrated collections of information systems. When viewing IIs through the lens of this theory, they can be seen as large actor-networks, including existing technologies, standardization bodies, software vendors, users and so forth. According to ANT, these actors interact and affect each other continuously. The heterogeneous network of actors (Latour, 1987) is constituted by various concerns, different degrees of power, and different perceptions towards the technology itself and its benefits. In order to reach stability in the network and to achieve an agreement among the different actors, the network must be aligned (Latour, 1999). The alignment is obtained through a process where the actors' interests are *translated* into agreeable expressions that are supported by for several actors (Callon, 1991, Law 1992; Latour, 1991). The adaptations that the actors conduct are part of these translations where an interest is translated into technological and social arrangements of material form. The translation may be inscribed into an artefact, and the artefact's *inscriptions* can be so powerful that they can restrict possible interpretations and enforce a desired behaviour. Callon (1991) describes the concept inscriptions as the result of translating one's interest into material form (Callon, 1991), and refers to the way artefacts embody patterns of action. When inscriptions become "institutionalised" they may become difficult to reverse.

The transition between actor networks can be durable, and by resisting alternative translations, the network risks evolving towards an inertial state, or approaching a relatively *irreversible* state (Hanseth and Braa, 1999; Rolland, 2002b). Callon (1991) introduces this concept, and explains that the degree of irreversibility depends on two things in the translation process of achieving a stable network (Callon, 1991). The first one is to which degree is it possible to go back to a point where the translation was one among several others, and to which degree other translations form and depend upon this translation.

> "*The more numerous and heterogeneous the interrelationships the greater the degree of network co-ordination and the greater the probability of successful resistance to alternative translations*" (Callon, 1991 p. 150).

ANT provides a broader understanding of the network's complexity, and helps us to see how borderline issues and inscriptions are hidden in links between the various actors (the concept borderline issues will be elaborated in section 2.3.2). In addition, the theory provides a deeper understanding of the translation process of actions and motivations of heterogeneous actors.

2. 2 – Information Infrastructure Systems (IIS)

Recently, there has been a growing interest for Information Infrastructure (II) that led to an increased focus on developing new strategies for information systems. Over a long period, there has been a transformation from developing isolated information systems, towards the integration of large numbers of systems that becomes part of a larger infrastructure. An information infrastructure (II) can be seen as an Information System (IS), but there are some paramount differences that bring to light several theoretical concepts. Hanseth and Monteiro explain that Information Infrastructure (II) is a vast field that "covers all kinds of use and use areas. It involves extensive political, social, organisation, human aspects and issues- from the development of industrial at national, regional (EU), or even the global level" (Hanseth and Monteiro, 1997, chap 1). They see information infrastructures as the "next generation" of Information Systems (ISs).

I choose to apply the Information Infrastructure (II) perspective since it gives a framework that helps to understand the patient record in a broader way than the traditional Information Systems (IS) perspective. This implies that systems are described as elements in a larger infrastructure, including both technological and social actors.

I will begin by outlining and presenting the key aspects of Information Infrastructures (IIs), and describe the implications of using this perspective for change. Thereafter, I will discuss the increasing need for a newer approach than the traditional one. Subsequently, I will outline strategies for conducting a change and managing a transition, as well as explain the importance of these when dealing with scaling and evolving IIs. Finally, I will provide a theoretical background for some of the studies conducted using the Information Infrastructure (II) perspective.

2. 2. 1 – What is an Information Infrastructure?

Information Infrastructure is more than just the physical facilities that are used to transmit, store, and process information (data, voice and images). In *Webster's Dictionary*, infrastructure is defined as:

> "*A substructure or underlying foundation; esp., the basic installations and facilities on which the continuance and growth of a community, state, etc. depends as roads, schools, power plants, transportation and communication systems, etc*." (Gurlanik, 1970)

Another interesting definition of an infrastructure is the one given by Leigh Star:

> *"…an infrastructure is embedded; transparent; having reach or scope; is learned as part of membership; has links with conventions of practice; embodies standards; is built on an installed base (and its inertia); becomes visible upon breakdown; and is fixed in modular increments, not centrally or from an overview*" (Star, 2002, p. 117).

An infrastructure resource is characterized by several aspects that show the difference between infrastructures and other information systems. I will now look more deeply at the key aspects of IIs and, then gradually move towards the implications of these on the design and implementation.

The first aspect of infrastructures is that they have an *enabling* function. Infrastructure supports general use, and should provides basis for any user to develop and implement any applications consistent with its goals. It is not designed to support only

improving or automating something that already exists, but also to open up a field of new activities.

According to the definition that was found in *Webster's Dictionary*, infrastructures are *shared* resources for communities of practice (e.g., organisations, people). Infrastructures are not like traditional information systems which are viewed as individual tools that are developed for specific purposes and local processes, and are used by a limited and homogeneous group. When one module (application) is integrated with others through information exchange, the other modules become dependent on the data that is exchanged. This way, the first module becomes a shared resource.

A key characteristic of infrastructures is that they *evolve* continuously through extensions and improvements. Gradually, the infrastructure is extended to include new applications, and the number of users and use areas increases.

The fact that infrastructures are characterised by continuous growth and evolution leads to the next aspect which views, infrastructures as *open and scaled*. This means that there are no *a priori* definable limits regarding the number of technologies, users, and user-areas, and that infrastructures can expand in a structured way in order to ensure consistency in the level of service. In addition to the multiple purposes and users that evolve over time, the development time frame of infrastructures is open, meaning that it has no day of birth or death (no defined beginning or ending) (Hanseth, 2002).

A large infrastructure involves various users with different, and sometimes contradicting requirements. In order to make the whole infrastructure work, it is advisable to relate to systems that follow *standards* in order to decrease the complexity of the integration with other systems. Hanseth (2002) asserts that the structure of an infrastructure can be described by standards, and he therefore sees "standards and infrastructures as the flip sides of the same coin" (p. 7).

An infrastructure is a *socio-technical* network, which includes more than just technological components. Among others, it includes actors, knowledge, use situation and procedures around them. Infrastructures are *heterogeneous* in the sense that they include elements of different qualities, humans and computers. They are also heterogeneous in the sense that the same logical function might be implemented in several different ways. Heterogeneity can occur in several forms, for instance, when one standardized part is being replaced by a new one, when large infrastructures are developed by interconnecting two existing ones, or when larger infrastructures are built based on existing, independent components. An infrastructure is built upon an *ecology of distributed networks* (Star, 2002). It is built as a layer on another technology, and integrated with other infrastructures into networks. Drawing upon this anti-reductionist perspective of ecologies of networks, emphasises the importance of viewing infrastructure as a shared irreducible unit which includes heterogeneous and tightly interconnected components, such as humans, technological components, organisations and institutions. Hence, infrastructures cannot be adequately understood if they are decomposed into separate and independent modules.

An important aspect is that infrastructure is developed through extensions and improvements of the *installed base*. Building a large infrastructure takes time, and as time goes by, the infrastructure has to adapt to the new requirements that occur. Since the whole infrastructure cannot be changed simultaneously, the new infrastructure must be designed in a way that it can be linked to the old one. In other words, infrastructures are never developed from scratch, but rather developed by interconnecting and interrelating existing components. Consequently, the present installed base, that is to be built, carries

heritage from (and is affected by) the former installed base. Depending on the size, the degree of heterogeneity, and the degree of flexibility, the installed base can affect an infrastructure to move towards an inertial state.

In summary, the concept of infrastructure should not replace the concept of system, but should rather be used as a complementary aspect (in addition to that) of system (Hanseth, 2002). The notions of system strategies for planning are still essential when developing new components that will be integrated in infrastructures. The additional aspect is that IIs are shared by a large number of heterogeneous users, and their development is heavily influenced by the importance of the installed base and standards. These are important subjects that either have been taken for granted, or have not been appreciated enough in management literature (Hanseth and Monteiro, 1997). Therefore, in the next section I choose to describe the implications for change, and discuss the role of the installed base in relation to change.

2. 2. 2 – Implications for change

The complexity and unpredictability in design and use of Information Infrastructures (IIs) is higher than what is faced in traditional Information Systems (ISs). Hence, many of the systems that exist today call for an increasing need for a new perspective (Hanseth and Monteiro, 1997). The term Information Technologies (IT) has been extended to Information Communication Technologies (ICT), and this reflects on the extension of change processes related to the nature of information systems (Hanseth, 2002). The most obvious change is the growth in the number of systems in use, the number of users, developers, and use-areas.

Traditional IS design is different from the design of IIs in several perspectives. Due to the inherent assumption from IS design methodologies saying that the systems to be developed are designed from scratch, the design process starts by uncovering and specifying user needs. IS methodologies focus on the development of closed systems, meaning single, isolated and stand-alone systems (Hanseth, 2002). The design phase is an event that follows a closed time frame which is supposed to have pre-defined start and ending time-frame (Orlikowski, 1996).

As mentioned above, IIs are built upon the installed base, and not from scratch. This implies that the new or improved elements have to be aligned with the existing ones. In this process of designing or changing an II, the role of the installed base becomes very crucial as it heavily influences the design of the new elements. Over time, the installed base grows and develops inertia which becomes increasingly more difficult to modify. Hanseth (2002) prefers to see the installed base as "a sort of a living organism that can be cultivated, rather than some dead material to be designed" (p. 2). Therefore, Hanseth (1996) points out the need for a shift in the way we think regarding the design of Information Infrastructures, and suggests transforming from perspectives about "constructing" to "cultivating" the systems. Constructing IIs implies that we have the ability to know in advance what is being built and the intended use. However, the fact that IIs are large and complex, and have a long lifetime, makes this degree of control impossible (Nilsson et al., 2002). Berg (1997) argues that the degree of control disappears when tools and practices are conceptualised as networks that are too comprehensive to control. "Rather, control is distributed among them in intriguing and poorly understood ways- and it is in this distribution that the power of resulting hybrids lies" (p. 124). Cultivation on the other hand, allows IIs to evolve over time. Dahlbom and Mathiassen

(1993) argued that constructed systems extend and evolve far beyond what was planned, and they seldom achieve what they were designed to achieve. This is a paradigm shift from system construction to system evolution. Hanseth (2002) argues that successful development of infrastructures requires strategies for creating and managing such processes, for instance cultivation and gateways which can link various elements (Hanseth, 2002). Nilsson, Grisot and Aanestad (2002) pointed out that:

> "*the complexity and unpredictability of IIs guide us to think in terms of cultivation and evolution. The need for future changes, additions, improvements and so forth emphasise the need for both openness and flexibility in terms of technologies and standards*" (Nilsson *et al.*, 2002, pp. 10-11).

There are various strategies and mechanism for conducting changes and managing transition strategies. The first strategy to conduct a change is choosing a revolutionary approach. Following this approach implies conveying a dramatic change using for example flag-days. This way, it is decided for instance that on the following day, all paper-based documents will have to be scanned, and it will therefore not be allowed to send any paper-documents to the archive.

Michael Hammer claims in his article "Reengineering Work: Don't Automate, Obliterate", that managers should "use computers to redesign, not just to automate existing business processes" (Hammer, 1990, p. 104). Moreover, he emphasises the need for reengineering businesses in order to achieve improvements in performance. According to Hammer, reengineering cannot be accomplished in small and cautious steps; it is rather "an all-or-nothing proposition with an uncertain result" (Hammer, 1990, p. 105). His approach is very radical, implying removing the existing infrastructure and replacing it with a new one. Applying a revolutionary approach is not feasible in such a large and complex infrastructure as the one existing in the hospital, and I therefore refer to the other approach.

When implementing such a complex II, one needs to follow an evolutionary approach, where the infrastructure is being changed through a partial and stepwise process where smaller parts, sub-networks, are replaced by new ones. When viewing II though the lens of Actor Network Theory, as outlined in section 2.1 earlier, a sub-network here is a unit that consists of several components which are interlinked in a larger actor-network. The various sub-networks can be linked through "gateways" that maintain communication between them (Hanseth, 1996). Applying the evolutionary approach implies that the existing network, which is the installed base, is being seen as a design starting point (Hanseth, 1996). Thereafter, sub-networks are being changed following stepwise incremental changes at a time, while aligning the new components with the rest of the network. This increases the chances for a successful transition over time between stability and flexibility (change) for the different components (Hanseth, Monteiro and Halting 1996).

It has been proven that re-designing existing components, or introducing new components, often tends to reflexively produce unintended side effects. An information infrastructure is built on components that are or become interdependent. Therefore when one of the components is extended or re-designed, this often has consequences for other components in the entire network (Hanseth, Ciborra and Braa, 2001). Hereby, I will elaborate in the next section on the importance of transition strategies for scaling and evolving information infrastructures.

2. 2. 3 – The importance of transition strategies

As previously outlined, an information infrastructure is a large and tightly interconnected network, constituted of heterogeneous socio-technical elements. An infrastructure has to gradually evolve and scale through extensions and improvements, in order to meet the new requirements. Monteiro (1998) points out that "scaling an information infrastructure is neither trivial nor automatic" (Monteiro, 1998, p. 230), and describes scaling an infrastructure as a process that is caught in a dilemma. On the one hand, the expanding infrastructure accumulates pressure for making changes. However on the other hand, this has to be negotiated and balanced against the conservative influence of the existing installed base. Among others, this influence refers to technical, economic and organisational investments (Monteiro, 1998). The complexity related to the design of information infrastructures in terms of balance is also described by Rolland (2002b)[4]. The Rolland presents the need for standardization and interconnections across contexts on one side, and how these have to be balanced against the need for flexibility and customizability in local context, on the other side (Rolland, 2002b).

Changing a large and complex infrastructure, such as the medical information infrastructure, is profoundly challenging. The main question in this case is not how paper-based records will be changed to electronic records, but how the process of change and evolution itself will be managed. A transition strategy should be a descriptive plan which outlines each evolutionary step, including "negotiations about *how* big changes can- or have to- be made, *where* to make them, and *when* and in which *sequence* to deploy them" (Monteiro, 1998, p. 230). II design acknowledges the importance of finding transition strategies; however, this is different from the traditional IS design.

2. 2. 4 – Information Infrastructure theory applied to EPR studies

There are various studies that analyse and describe Information Infrastructures (IIs). In this sub-section I would like to give a brief overview of some of the central related researches. Berg and Bowker (1997) for instance, focus on the role of the record as an organisational infrastructure, and how it serves various aims, as well as allowing interplay and coordination of different worlds (Berg and Bowker, 1997).

Another interesting aspect is introduced by Ellingsen and Monteiro (2000) in their study of the Norwegian Medakis-project that includes the introduction and use of EPRs in the five largest university hospitals in Norway (Ellingsen, 2002a, 2002b; Ellingsen and Monteiro, 2000). They describe the complexity of an EPR in the work, and illuminate the resources beyond the record itself. Another example is the study of the digitalization of radiological practice by Lundberg (2000), where she emphasises the importance of network and information infrastructure perspectives (Lundberg, 2000). In his Master thesis, Karl Dahl (1998) describes the paper-based record in an information infrastructure perspective based on a case study conducted in the Children Clinic at Rikshospitalet. He describes the record as a central and common resource in a large heterogeneous infrastructure that is built upon a complex interplay between social and technological actors (Dahl, 1998). Hanseth and Monteiro (1997) emphasise the importance of using the Information Infrastructure perspective, which implies viewing the EPRs as part of large, complex, interconnected and irreversible networks (Hanseth and Monteiro, 1997).

[4] Knut H. Rolland conducted an interpretive case study of design and use of a large-scale information infrastructure system in a globally distributed ship classification company (Maritime Classification Company).

As we can see here, the need for II perspective is partly recognized, and there were various researchers who contributed with insightful studies of the challenges and strategies for designing Information Infrastructures. However, (Nilsson et al., 2002) argue that there is a need to understand what the implications of this may be, rather than just presenting it as a challenge. They illuminate that the currently implemented EPRs in the Norwegian healthcare have been developed and implemented with traditional IS thinking. As a consequence, "many hospitals are struggling to integrate these complex and rigid systems with other, both existing and newly developed systems, in order to expand and create a sufficient II" (Nilsson et al., 2002, p. 6). Moreover, they argue that "the healthcare is again risking expanding the existing II in a way that makes future changes of the II even more difficult and costly" (Nilsson et al., 2002, p. 6). They emphasise that there is a need to analyse the existing body of knowledge regarding how to develop such technologies, and to study the implications of the II perspective (Nilsson et al., 2002).

2. 3 – IT and Work Practice

In order to understand how the electronic patient record affects the medical work, we should first acquire more knowledge about the organisation of the medical work practice, cooperative work in teams, and the use of artefacts in the medical work. This knowledge will eventually support the design of systems that are adapted to the existing work practice in a better way than the traditional IS design did. Hence, I will try to provide a theoretical framework by applying work practice oriented concepts (situated practice of use), and emphasise the *use* aspect in situated practices. I would like to draw upon Rolland's paper[5] where he attempts to conceptualize the mutual transformations of information infrastructures and situated practice of use, and outlines the implications for that (Rolland, 2002b). Rolland explains that through the use of an information infrastructure, users have to reconsider their knowledge which is based on experience, and their context dependent situated practice of use. However, this is a dynamic reflexive process where information infrastructures are also locally shaped and re-invented through situated practices of use. He uses the concept of re-inventing to refer to the ongoing learning process where users try to configure various ways of utilizing the technology (Rolland, 2002b). In summary, Rolland emphasises the mutual, dynamic and reflexive transformations of information infrastructures and situated practices of use. Drawing upon Rolland's concepts, helps us explore the complex interplay that exists between context dependent and situated practices of use, and various processes of innovation.

The previously mentioned complex interplay between situated work practices and innovation processes of IIs has various implications. Using the lens of Information Infrastructures shows us how the community of practice (i.e. organisation, people) is ordered, how information is retrieved and changed, etc. However, using action/work oriented concepts to describe situated practice of use, and viewing them through ethnographic eyes, allows us to go between layers and analyse formal and informal aspects of communication, as it focuses attention on fringes and materialities of infrastructures (Star, 2002). Star (2002) argues that by analysing the roles of

[5] The Boomerang effect: in Design and Use of Information Infrastructures: Evidence from a Global company, Rolland, K. Draft-Submitted to the *Information and Organisation* journal.

communication tools and learning to read invisible layers of control and access, the researcher acquires an understanding of the changes in the social ordering that are caused by information technology. In her article she gives examples of unusual research topics that most scientists would find adequately boring, for instance investigating medical schemes (Star, 2002). Thereafter, she explains that

> "*these behind-the-scenes, messy or boring items form a crucial part of the materiality of how […] work is done. […]. What they have in common is a concern with infrastructure, the invisible glue that binds disciplines together, within and across their boundaries*" (Star, 2002, pp. 108-109).

By deconstructing the backstage parts of infrastructure, we dissemble the narratives and backstage decisions that it contains, and obtain a deeper understanding of the social structure, such as values and work practices embedded in these tools.

In this section, I begin by exploring the medical work practice by drawing upon Strauss's concepts: illness trajectories and articulation work. Thereafter, I explain the artefacts' roles, using Berg's concepts of accumulation and coordination. In order to describe further the artefacts' properties, I used the concept of borderline issues. Finally, I draw upon processes that integrate both work practices and IT in use, in order to acquire a better understanding of the infrastructure development and growth.

2. 3. 1 – Work practices: Trajectories and Articulation Work

In order to decrease the degree of complexity of the transition to an electronic patient record, the design of EPRs in Norway was to a large extent based on the paper record. This applies to both the structure and the user interface of the record, in order to minimize the changes. Still, implementing the electronic patient record requires new work routines and practice. This is challenging for several reasons. One of the reasons is that the hospital is a tremendously complex organisation, which includes various work professions that have different interests. In order to illustrate this, I would like to refer to Strauss et al. (1985) who explain that managing a trajectory involves carrying out several lines of work, where each one is constituted of tasks' clusters.

> *"In common parlance, the physician arrives at an overall plan- a kind of trajectory blueprint, the head nurses guide its implementation, while the other health workers, including nurses and technicians, carry out the requisite operational tasks with more or less competence and dispatch. The central figure in the planning is the physician, but the key actor in the articulation drama itself is the head nurse"* (Strauss et al., 1985, p. 151).

The articulation of a trajectory requires interaction and interplay between different types and modes of work such as: nursing, medical and technical tasks, and so forth. Strauss uses the concept 'articulation work' in order to emphasise the collaborative aspect in terms of coordination and reaching common understanding (Strauss et al., 1985).
The medical health personnel deal with various diseases that require heterogeneous work practices and resources. Such work practice is different from an industrial site where limited types of products can be produced. In addition to involving various departments and work professions, activities must be conducted in a specific sequence. Strauss emphasises that each patient *illness trajectory* involves different schedules, actions, skills, sources, and contingencies.

Strauss et al. (1985) use the term *illness trajectory* to refer to the comprehensive organisation of work around the patient, and illuminate that: "The concept of trajectory is especially useful in thinking about the experimental and identity impact of work in hospitals because it brings out the *evolving* character of that work and work relationships over the course of the entire case" (p. 39). The health care sector is different from other sectors due to the high level of unpredictability in processes. The articulation of the medical work in hospitals is highly complex, and various unexpected contingencies may arise. Moreover, a patient trajectory usually involves several services, and the likelihood that schedules will go awry is high and demands *ad hoc* rearticulation of work. Strauss outlines several sources of potentially disruptive conditions that may occur. For instance, a machine breakdown, or emergency situations may suddenly occur and change totally schedules of trajectories. The available resources, in terms of drugs and equipments, might also affect the articulation of work. Hence, trajectories are not simple and linear.

In addition, the development of the patient's condition, physical and psychological response to the treatment cannot be fully predicted, and the patient can prove to be allergic to a medicine. Patient trajectories cannot be foreseen, due to the fact that trajectories vary greatly depending on many aspects. An illness for instance, can prove to be unpredictable and cause to post-surgical infection or other complications.

The above mentioned shows the complexity of the medical practice and the interdependencies between the various elements, actors and departments. These interdepartmental dependencies imply that changes will have consequences for other elements in the organisation. Therefore, changes must be conducted in a coordinated form in order to prevent disruptions in the workflow due to one department's adaptation of a new work practice.

The heterogeneous work practices presented above are surrounded and supported by various artefacts. In the next sub-section, I will look deeper at the artefacts' properties and roles in the medical practice.

2. 3. 2 – Artefacts in work

Artefacts' roles

I believe that obtaining a better understanding of the use of artefacts is a way to facilitate the transformation from paper-based to electronic patient records. To explore the impact of EPRs on the conventional work practice and on interdependencies in work, I choose to describe the artefact's roles and their properties.

There are various studies undertaken within the Computer-Supported Cooperative Work and Information Systems communities, that analyse the central role of documents and their evolution in organisational management. These studies view reading and writing artefacts, such as documents, as more than a static carrier of information that can be replaced electronically. Yates (1989) for instance conducted research describing the use of documents for information flow and management (Yates, 1989). Heath and Luff studied the role of the patient record in professional practice, and showed how the paper documents are central in the work and the interaction between doctors and patients (Luff and Heath, 1998; Luff, Heath and Greatbatch, 1992). Lundberg and Sandahl studied the digitalisation of radiological practice. They argued that in order to understand how the artefacts are embedded in the work, we must consider the artefacts' central, peripheral and shared properties (Lundberg and Sandahl, 2000). Those shared properties are referred to as: borderline issues. Lundberg and Hanseth, studied the artefacts' ability to trigger work activities and support coordination (Hanseth and Lundberg, 2001). Other

researchers who studied artefacts in workflow are Brown and Duguid (1994) who discuss the importance of taking into account borderline issues when a new system is being developed. Star and Griesemer (1989) discuss boundary objects, referring to artefacts that cross the border between various communities (Star and Griesemer, 1989). They explain that when artefacts are changed, their properties (inscriptions) disappear and this has a tendency to send unpredictable waves.

I would like to relate to Berg (1999), who conceptualises information technologies in work practices as types of reading and writing artefacts. Such artefacts as, records, lists, whiteboards, progress notes and forms, are central in managing a patient's trajectory. This is due to the fact that these tools alter activities and transform work practice. The medical record for instance, "is an artefact that feeds into the content of the medical decisions made, into the doctor-nurse relationship, into the organisation of medical work and into the figuration of the patient" (Berg, 1999, p. 375). Hence, reading and writing artefacts are embedded in and dependent upon the current medical practice.

Berg points out that these tools, the reading and writing artefacts, are active participants in work practices as they *accumulate inscriptions* and *coordinate activities.* To illustrate this, Berg gives an example where he describes the activities that are implied in ordering a blood test, and shows how the order form *coordinates activities* of several interrelated heterogeneous entities. He describes the coordination and organisation of work that is constituted in such activity as ordering blood tests.

> *"A whole series of entities come into play: the doctor who jots down the order, a nurse who reacts upon the order by administering the antibiotic, collecting the blood at the proper times and sending it off, the laboratory assistant who processes the shipments of blood tubes and forms"* (Berg, 1999, p. 382).

The order form articulates the activities of the various entities.

> *"Its material presence, in a fixed place on the ward, and its structured layout afford the linking of actions and events over different sites and time without 'face-to-face' interaction between the doctors and nurses"* (Berg, 1999, p. 386).

He explains further that the laboratory forms also play an active role through its lay out. Such forms are designed in a way that reflects on the historical and chronological order of the requests, and in this way, the forms acquire a brief history of the patient's medical interventions. The recent requests are at the bottom of the list, and the requests which have not been dealt with yet, are those without initials in the right column. Thus, the horizontal lines distinguish between previous and current requests, and the vertical lines separate between responsibilities. According to Berg (1999) "the constant adding of entries turns this form into a dynamic artefact" (p. 387) that provides an overview of the medical intervention, and the current state of affairs. Hence, the order form *accumulates inscriptions* which are the entries that doctors and nurses write in a specific and structured way, and these alter activities that are involved in ordering tests. Consequently, the form allows nurses and doctors to articulate their work without synchronous communication.

There are both similarities and differences that can be found when comparing between paper and computer-based reading and writing artefacts. Both mediate the practices of which they become a part. However, paper-based reading and writing artefacts have special properties that make them suitable in both synchronous and asynchronous collaboration. They have a high 'tailorability' in terms of affording strategies for fast

retrieval and oversight (Nygren and Henriksson, 1992) better than the computer-based reading and writing artefacts. One has the possibility to tailor paper documents by for instance, underlying or marking text with colour pens in order to differentiate particular items, or to alert irregularities in treatments (Luff et al., 1992). Textual features such as handwriting and ink colour, may provide health personnel with a rich body of resources (Luff et al., 1992). Moreover, the paper-based artefacts have 'ecological flexibility'. This refers to the capability of documents to be adapted to a range of situations and contingencies. A physician can for instance examine a patient and look at the record simultaneously. A paper is a portable artefact that has micro-mobility, meaning it can be manipulated and easily reordered (Luff and Heath, 1998 p. 307).

However, the paper-based reading and writing artefacts can only be physically present in one location at a time. On the contrary, computer-based reading and writing artefacts have the possibility to collect and assimilate inscriptions and to rapidly interconnect locations that are geographically separated. Computer-based order forms can prompt messages to the appropriate individuals, for instance when a previous entry has not been checked off, or when a new entry has been made.

In sum, we can see that artefacts have various important roles in the medical practice as they coordinate activities and accumulate inscriptions. Next, I will take a step ahead and look deeper at the artefacts' properties.

Artefacts' properties

I would like to present the concepts *borderline issues* in order to enrich the understanding of artefacts and their properties, and their significance in work practice conventions. This is essential for understanding the transformation from paper to electronic documents. John Seely Brown and Paul Duguid provide in their article an analytical framework that helps in understanding the consequences of introducing technological artefacts in physical, psychological and social contexts (Brown and Duguid, 1994). They offer concepts that provide us with a deeper understanding of how technology is interlinked to its context.

According to Brown and Duguid (1994), artefacts have both central and peripheral properties, and these vary in different contexts. The central resource has a shared meaning for everyone, while the peripheral resource has a private meaning for an individual. Between these, there are borderline issues which are resources that are shared and constitute a social meaning for a group of people (Brown and Duguid, 1994). Borderline resources lie outside of what we usually see as part of the artefact. They develop gradually over time, as artefacts are embodied into practice, and social conventions are developed. .

The peripheral resources can develop to borderline resources when the artefact forms a starting-point for development of practice around it. An artefact, its borderline resources and its use areas, cannot be understood without its community of practice (Lave and Wenger, 1991). This refers to the social world where practice is common, coordinated and reproduced, where meanings are developed, and therefore borderline resources and conventions around these are shared.

Artefacts that span borders between communities of practice have an internal role that they play within a community, and an external role that they play between communities of practice. The concept of borderline issues makes us focus on the artefacts' peripheral properties and their significance in work practice conventions. When artefacts are

changed, these properties disappear and this has tendency to send unpredictable waves. Susan Leigh Star calls such artefacts that cross the border between various communities, "boundary objects" (Star and Griesemer, 1989).

As the technological development accelerates gradually, the number of the artefacts that are being implemented electronically increases. This implies that artefacts lose their material and social continuality. Brown and Duguid emphasise the importance of taking into account the borderline issues when a new system is being developed (Brown and Duguid, 1994). Moreover, it is paramount to consider that what was implicitly interlinked to the artefact's physical properties, must now be provided explicitly by the developer, in order to avoid losing important properties that the artefacts have (Brown and Duguid, 1994). Paper documents, shelves and tables, support coordination work in medical practice; these will disappear when documents become electronic. "The process of carrying them, sorting them, placing them or using them becomes invisible"(Lundberg, 2000, p.30). Hence, in the process of transition from paper to electronic documents it is important to acknowledge the borderline resources.

The concept of "borderline issues" complements ANT's concept of inscriptions in the understanding of the technology. Both concepts emphasise the roles and the "use" aspect of technology. Borderline meanings of a complex technology are hidden in links of the artefacts, the users, social conventions and other elements in the work practice. Identifying borderline issues, such as for paper-based referral letters is challenging, as referral letters are being seen as more than just static artefacts. Applying the concepts of borderline issues and boundary objects enriches the perspective of actor networks. The borderline issues emphasise the central and peripheral properties, and the boundary objects emphasise the local and shared properties.

2. 3. 3 – The intermeshing of work practices and IT

When a new information system is introduced, a mutual process occurs where both the system and the practice are simultaneously negotiated, and disciplined and aligned to each other. Berg (1997) elaborates how information systems need to adapt to the existing work and routines (Berg, 1997). According to Berg, both the tool and the practice are simultaneously transformed in this process, and produce accordingly a new situation that did not exist prior to the tool. Berg argues that this transformational potential had been neglected in many research studies within the CSCW field. An essential aspect that can be found in Berg's argument is that the tool and the practice should not be conceptualised as two singular homogeneous entities. Rather, they are heterogeneous networks that include practices, tools, people, routines and so forth. Hence, the transformation process is not an alignment of two singular entities, but rather of two comprehensive networks (Berg, 1997).

We take a step further and move from the mutual transformation process, to dividing the process intro three parts. Aiming to acquire a better understanding of infrastructure development and growth, I choose to refer to Gasser (1986) who suggests three processes that integrate computer systems with work practice (Gasser, 1986). These processes include adaptation, extension and evasion of the system. These processes can shed new light on the adaptations that need to be done in an infrastructure that integrates technology and people. The first process, which is adaptation, refers to adapting the

computer system or the work practice in order to compensate for the weaknesses and to accommodate the misfit in the system. Gasser (1986) illuminates how users tend to adapt their work to the new information technology, by developing different kinds of 'work arounds' and undocumented strategies in order to compensate the "gap" between the technology and their context dependent work practice (pp. 205-225). Extension of the work practice is the second process, and it refers to situations where extra work is needed in order to compensate error or absence in the system. An example of this is the extension that had been developed after the implementation of the EPR at the Children's Heart Section (CHS). This section use a specialized information system called 'Berte' which has a functionality that extends beyond the "local patient record" role. Since this specialized system has been used since 1990, it could not be replaced by the electronic patient record. Consequently, the two systems are being used simultaneously, and extra work is needed. The secretaries developed routines where they write the documents in DocuLive EPR, and then cut and past the text into Berte (Nilsson et al., 2002). The third process is evasion of the system, and this appears when the user consciously uses the system in a different way than it was designed for, or when the users avoid using the system by sustaining alternative ways of performing the work. Gasser found in his enquiry that these three processes are essential for finding local rational ways for how to use the system (Gasser, 1986). The expectations and demands to the work practice increases, and due to this the technical system must continuously be adapted to the evolving work practice.

In sum, there have been several attempts to provide a framework that theorizes the interplay between the technical aspects of IT and the social (use) (e.g. Orlikowski, 1992; Orlikowski and Gash, 1994; Orlikowski and Robey, 1991; Walsham, 1993, 1997), and elaborate how the use of information technologies reveals itself in practice. In addition to Gasser (1986), Orlikowski (1996) conducted a study where she illuminates the use of groupware application in a customer support department (Orlikowski, 1996). Orlikowski (1996) discusses information technologies in use, and argues that work practices and organisations are shaped mutually through "ongoing improvisations enacted by organisational actors trying to make sense of and act coherently in the world" (p. 65). Hence, she views transformations as situated change rather than determined by the technology alone.

2. 3. 4 – Related research

I relate my research to studies undertaken within the Computer-Supported Cooperative Work and Information Systems communities. In addition to the studies that were previously mentioned in section 2.3.2, I would like to mention several others. Considerable work has been done by Marc Berg who studies the role of formal tools in medicine, and emphasises that these tools are more than 'transparent' and 'supporting' tools (Berg, 1997, 1999). Berg emphasises that these tools are not only active and constitutive partners in the work, but they also transform the work tasks and the organisation of these. Moreover, he illuminates the complexity of medical work around a patient, and the need for coordination that this entails (Berg, 1999). Løbersli (2001) illustrates the importance to look beyond the radiology ward when implementing an information system for digital images, and explains that in order to succeed in such digitalisation processes, the ordering wards have to participate in replacing their paper-based order forms with digital ones, as the radiology ward has done (Løbersli, 2001).

Strauss et al. (1985) who focus on the social relationships and complexities of medical work, and provide theoretical concepts for understanding workflow and work processes (Strauss et al., 1985).

In summary, all these studies show us how implementing an electronic patient record changes not only one element in this interplay between the paper record and the electronic record, but also the work practices that were developed around it. However, the medical record and the work practices are not singular elements, but rather part of a large heterogeneous socio-technical network that includes situated work practices, artefacts and tools, people, etc.

By following the Information Infrastructure (II) perspective, the focus is directed towards the fact that development of IIS is heavily influenced by the installed base and its heritage. Thereby, the development of an infrastructure is constructed trough extensions and improvements of the installed base, while interconnecting and interrelating existing components. However, the IIS perspective does not provide us with knowledge about the organisation of the situated work practices (e.g. accumulation and coordination of the medical work practice), or tools to understand the roles and properties of artefacts in the medical practice.

On the other hand, practice oriented concepts from the CSCW literature provide us with knowledge about both the heterogeneous work practices and the use of artefacts in the medical practice. However, following this orientation, neglects the importance of the installed base of the information infrastructure.

As will be elaborated later (in the discussion), the IIS perspective lacks focus on issues that are being illuminated by the work practice orientation and vice versa. Aiming to understand the change and transition processes of an information infrastructure, I chose to merge the two perspectives as they together provide a broader/integral understanding of the process. As mentioned earlier, the transformation process is not an alignment of two singular entities, but rather a dynamic evolving process of two comprehensive and heterogeneous socio-technical networks. My objective is not to advocate one perspective or another, but rather to shed light on the need for merging the two perspectives. Despite the fact that there are various empirical studies that focus on the role of the technology in work practices, “there is still a lack of empirical studies that investigate the dynamics of the process where technology and work practices evolve together” (Aanestad, 2003, p. 2)

3. Historical Background for the Case

3. 1 – The Evolution of the Patient Record Infrastructure

In this section, I would like to describe the historical background of the Information Infrastructure (II) that existed before 1996, when the Medakis project was implemented. For this purpose, I turn to elaborate on the overall Information Infrastructure (II) that consist of various technologies, routines and procedure, artefacts etc. I will refer to the previous II (that existed before the implementation of the EPR) as the installed base, and describe the challenges and complexities that were faced through the evolution process of the paper record infrastructure and the development of the EPR.

The infrastructure of the Information System (IS) was highly fragmented. There were various local departmental archives, and local paper records that constitute local forms which were in use by only few departments. Thereby, the paper-based medical record was distributed, place dependent and loosely coupled. Local departmental archives implied that a patient who was admitted to several departments, had several medical records which were not linked to each other. Moreover, the medical record was fragmented and contained redundant information, and provided therefore poor and limited support for data integration and transfer across departments. In other words, finding a complete overview of the articulation of the patient's illness trajectories in the various departments was almost impossible.

Beside this, the technological infrastructure was also very fragmented, and various independent IT strategies and solutions were in use based on local initiatives. Different operating systems were in use (both PC's and Mac), and the various departments had their own infrastructure (if they had any network at all). They were running and drifting their own servers. Consequently, there was a lack of integration and communication across the various departments. The Patient Administrative System (PAS) that was in use in the hospital is PiMS (Patient Information Management System), which contains demographic and diagnostic data for each patient for management purposes, i.e. non-clinical use[6].

There were several small local systems that were often developed by doctors who were amateur programmers. This included extensive non-integrated different spreadsheets systems, text processors, and other in-house systems. These local systems were usually serving local needs of organising data, and are still being used by few departments. Examples of such stand-alone systems are: Laura, which is an in-house local system used by few departments; DataCor, which is a research database used in the cardiology; and Berte, which is the specialized patient record systems for paediatric cardiology. Many of those systems were e.g. Access databases which were often unstructured and poorly documented. Most of these local systems have survived until today, and since they represent an important and efficient part of the departments'

[6] Patient Administrative System (PAS) contains basic demographic information (like name, date of birth, addresses, etc.) and support for budgeting, accounting, resource allocation, and for planning waiting lists, appointments and patients' visits and stays. The EPR system imports information from PiMS, which imports information from the register office (Folkeregister).

practices, it is difficult and maybe undesired to remove them. They are well-established installed bases and are strongly embedded in the work practice.

Beside these IT systems, there were different information systems that were being used in the various departments. For instance, paper-based records, workbooks, medical-books, as well as many other binders, folders and books. All those were consisted of artefacts as trolley, large boards, tables, and shelves, that supported the existing information systems. In addition, various routines were established to support the existing medical work practice.

Several changes had been conducted prior to the introduction of the Electronic Patient Record (EPR) which replicated the content and the format of the paper-based record. The first change was standardizing the paper-based record. In 1993, the Norwegian Board of Health[7] (Staten Helsetilsynet, administratively part of the Ministry of Social Affairs and Health) published guidelines (the so called Piene report) inviting Norwegian hospitals to standardize the clinical information (document IK-2451). The guideline suggests indications on the content, the structure, and discusses issues concerning archiving and exchanging information. The guidelines suggest dividing the paper-record into two files, where the so-called 'A- active' files, contained recent documents, and the 'B-passive' file contained old information. In addition, it was suggested to use an index that divides the paper-record into ten alphabetic chapters (A-J), where each chapter contains various forms that are also divided numerically. Chapter B for instance contains the doctor's progress notes, chapter E contains images, and chapter G contains the nursing documentation. In 1995, Rikshospitalet decided to implement these national guidelines. A special professional group was set up in order to design and implement a local version of the guideline that will be adapted and customized to Rikshospitalet's infrastructure. This group had the responsibility to design the structure of the chapters, as well as designing the appearance of the paper-record, and the quality of the papers. Due to the fact that each department had its own local archive at that time, there were approximately 500-700 various types of forms. This shows the degree of the complexity and challenge that were embedded in standardizing the paper-based record. However, this was an essential process and formed a necessary pre-condition in the transition to an electronic record.

In 1997, the centralized archive was established, in order to support and provide proper storage for the paper-based records. However, it was only in 2001 that the new archive was ready to be used, and consequently, the de-centralized archives that existed in each department were removed. Hence, all the information that was diffused, fragmented and stored in the various departments was merged and archived in one place. This was in addition to establishing a policy that implies that each patient should have only one unique paper-record in the hospital. Establishing one centralized archive was expected to increase the quality of the content, reduce redundancy, and reduce the communication and documentation problems that existed (RH, 1994b). However, the actual achievement of this change was not an easy task, and this was not easily accepted within the various health personnel. Storing all the paper records in the centralized archive increased the physical distance and therefore decreased the availability. Moreover, the volume of the paper record increased dramatically after merging the

[7] In Norwegian: Statens Helsetilsyn. The Norwegian Board of Health which is an administratively part of the Ministry of Social Affairs and Health.

various form, and retrieving information (from specific department) became more difficult. Before continuing further, it is worth mentioning (clarifying) that the transition process of merging the record was never fully completed, as there are signs of re-emergence of local sections within the paper-based records.

Standardising the clinical information and establishing one centralized archive enforced changes in the existing work practice, procedures, and the everyday routines. These processes reorganised the system of health care professions, and they were not 'merely technical' events. These were extensions and improvements of the infrastructure of the paper-record, which is the installed base. Conducting these changes was a necessary and important process prior to the transition to an electronic patient record (since the standardized information structure of the paper record was replicated in the EPR).

In the meantime, there were several activities which decreased the fragmentation that existed in multiple levels of the infrastructure. Around the mid of 1990s, there was a diffusion of the first Personal Computers (PCs), and the IT department established a transition from the mainframe-terminal to Local Area Network (LAN) PC. Using one standardized Operative System (OSs) and installing a LAN, was part of the standardization process of the technical infrastructure. However, it is worth to mention that the consequence of diffusing the first PCs was that some clinical departments started developing their own local systems (as the ones that were previously outlined).
During the year of 1995, many new projects were established. Among those, there were projects of developing new laboratory systems. This includes a Radiology Information System (RIS), which contains text description of radiological pictures, and a Picture Archiving and Communication System (PACS) for digital archiving system for radiological pictures (x-rays). However, the implementation of these systems took place several years later.

One year later, in 1996, the Medakis project was implemented in the five university hospitals in Norway. As mentioned previously, the aim was to have one united system that would provide faster and better access to the information in patient records, as well as to increase the quality of the information. In 1997, a pilot implementation of the DocuLive EPR started at Rikshospitalet, and three clinical departments were chosen to be pilot departments. At the beginning of the project, the IT department followed an implementation strategy of fully implementing and adapting DocuLive EPR to each department separately This included customizing the functionality of the EPR to the local environments in each departments and to their unique needs, conducting special teaching sessions etc. This was the first phase in the implementation of an EPR system in the hospital.

Before the new millennium, the Y2K (year 2000) problem was approaching and there was no guarantee that the old technological devices were Y2K compliant (it was thought that the old technical devices would not be able to handle the date of the year (00), and crash). Due to this, and to the fact that Rikshospitalet was moved to a new facility in year 2000, the old hardware (HW) devices (constituting of old computers) were removed. In other words, this opportunity was used for replacing the technical devices with new ones. Beside this, in the 1st of January 2001, the law concerning the health personnel was

passed, and several groups of the health care providers, including the nurses, received a legal documentation duty[8].

The first phase of the adaptation process of the DocuLive EPR (1996-2001) proved complex, problematic, and proceeded slowly. The system was supposed to be expanded into the end product (v5.0), which should have been delivered in 1999. By the end of 2001, there were only 400 users out of 3500 target users. The IT department had to change the implementation strategy to installing the same standardized system in all the departments. Having full support from the management of the hospital, they aimed to reach the greatest number of users in the shortest time. This implied that new functionalities were not being added and customisations were not being conducted (e.g integration with local systems). DocuLive EPR included only text-based chapters from the paper record, excluding ECGs, roentgen pictures etc. It was only 30% of the paper record that was digitalized. The same standardized system was installed on all computers, in order to obtain benefits and establish an infrastructure which will allow exchanging of information across several units in the hospital. This strategy lowered considerably the complexity of the implementation, and allowed conducting the so-called "big-bang" implementation, referring to mass rollout of one standardised EPR system for all departments (Iacucci, Nielsen and Berge, 2002). This quick installation was done by using flag-days, meaning that at a given time and day, the health care providers had to start using DocuLive EPR. From 2002, the number of users increased from 400 to approximately 3000, which means that it has diffused throughout most of the hospital. The IT department supported the implementation process by establishing extensive supporting layers around it, including both technical and non-technical services. In addition to installing new technical devices, various introduction and follow-up meetings were conducted, teaching sessions (user training) were provided, and super-users that were provided with a fairly advanced knowledge about DocuLive where chosen. In addition, the IT department provided support in the field during the first week of installation, support service via the telephone, maintenance and distribution.

3. 2 – Current Status- Meeting the Local IT infrastructure

Aiming to draw a picture of the overall information infrastructure, I provided in the previous section a historical reconstruction of the evolution of the paper record infrastructure, including an introduction of the implementation process of the EPR system in the hospital. In this section I would like to describe the current status of the technological infrastructure that exists after the implementation process of the EPR system.

Currently, one can still identify the existence of many information systems that are being used simultaneously with the electronic patient record. I would like to outline some of those information systems, in order to shed a light on how hybrid and fragmented the existing technological infrastructure is. When looking for instance in the Neurosurgery department, we can identify various information systems such as DocuLive EPR which is the Electronic Patient Record, PiMS (Patient Information Management System) which is the Patient Administrative System, and EROS which is a laboratory

[8] "Dokumentasjon av sykepleie i pasientjournalen (en veileder fra Sykepleiernes forum for IKT og Dokumentasjon)- Var 1.1- August 2002"

system for retrieving blood-test results[9]. In addition, there are IT systems that are special for radiological pictures: PACS (Picture Archiving and Communication System), which is a digital archiving system for radiological pictures, and RIS (Radiological Information System) which contains text descriptions of radiological pictures. Moreover, there is a system that is specialized for planning operations, called Albert, and a system that contains the diagnosis book ICD10 in an electronic version. All the above mentioned systems, produce parts of the information in the medical record. Beside those systems, there is a system for retrieving telephone numbers of the healthcare personnel, called Telekat, and a special system for activating cards that patients buy when they want to have the possibility to receive phone calls directly to their room, which is called TelePAS Patient Telephone.

In addition to those IT systems, there are financial systems and Human Resource management systems. For instance, the ones that are used by the head nurse assistant at the Neurology department: Notus, which is for setting up the list of the different shifts and the vacations; and Svip, which is a system for budget planning and includes a statistic registration of the number of patients.

Moreover, there are few small local systems that are still in use by few departments. Examples of the stand-alone systems are: Nyre-base (kidney database), Scandia Transplant (ST), Living Donor, and Laura. Doris[10] is another local system, which is a multimedia program for storage and adaptation of pictures, and includes the possibility to write notes and comments. Those are in addition to the stand-alone systems that I have already mentioned before, Berte and DataCor.

Many of those systems accumulate fragmented, inconsistent and redundant information which is difficult to update. Consequently, this increases the possibility to make mistakes, and increases the size of the paper record that turns to be difficult to handle. Moreover, there are hybrid routines and procedures that were developed around the work practice for registering information in various systems.

Thereby, it is important to describe and clarify the increasing need for integration between the various ISs, and interconnection to the existing infrastructure. However, as time goes by, there has been an increase in both the number of systems and the number of interconnections to be created and maintained. So far, the vision of the EPR which implies having a single clinical information system, has been hard to reach. As an attempt to manage the fragmented infrastructure of systems in the hospital, the IT department have been strongly investing in designing a portal solution that will integrate and "glue" the various systems together using a common interface. This portal, dubbed as Clinical Systems All Merged (CSAM), is expected to allow simplification of the access to the systems (Iacucci et al., 2003).

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[9] EROS (Elektronisk Rekvisisjon og Svar): This system was installed after the implementation and installation of DocuLive EPR, after 1996. Since the function for requesting and retrieving blood test results in DocuLive was not implemented properly, EROS was installed as a temporary solution (even though we are already in year 2004, this function has not been implemented properly yet). EROS is not used for requesting blood test results yet, but only for retrieving results.

[10] Doris contains also a module for telemedicine. The skin-department was chosen to be the pilot department to test this program. Now (2003) the IT department is working on establishing a multimedia strategy and chose Doris to be a standard application. At the current stage, there are approximately 6-8 programs for picture-adaptations (håndtering). Example of these are: Photo Shop, Photo Station, Doris etc.

3. 3 – The Transition Strategy at Rikshospitalet

When looking at the transition from paper-based to electronic patient record using a macro-perspective, this transition appears as a radical and revolutionary. However, when taking a closer look at the transition, using a micro perspective, it becomes clear that it was conducted gradually following mainly an evolutionary approach. After the mass rollout of the standardized EPR system, incremental changes were conducted, and various versions of DocuLive EPR were gradually implemented and installed. For instance, DocuLive EPR 4.10 (which was installed in 2002) included the protected-record[11] that is used by special departments[12]. In the next version, DocuLive EPR 4.10 sp3e (installed in 2003), incremental changes were conducted in the desktop's interface and the icons, and Obstetrix (which is the birth-record[13]) was added for the Women's Clinic. The installation of each new version was done by using flag-days, implying that at a given day all the health care providers had to change over to the new version of DocuLive EPR. Subsequently when the implementation process was completed in all the departments, the EPR system had to adapt and evolve in order to accommodate the various needs within the departments. A few gateways and ad-hoc solutions were developed. For instance, customisations were conducted in the epicrises'[14] signing policy in order to accommodate the unique needs in the Neurosurgery department. This way, an assistant doctor from the Neurosurgery did not need to have a contra-signature from a head doctor, and all the doctors were given the possibility to sign each other's epicrise. Thereafter, stepwise modifications were conducted and new functions were gradually added to DocuLive EPR. This includes electronic prescriptions and sick leave notes. Having an overall aim of investing further in the electronic record, the IT department established several projects to extend the infrastructure of DocuLive EPR. Among others, there has been strong focus on implementing electronic internal referral letters, the scanning project, and order and response of laboratory test results (which will provide the possibility of ordering and retrieving electronically numerical values for clinic-chemical analysis, and is expected to replace EROS).

In sum, we see here how the IT department had been following so far an evolutionary approach, where the infrastructure had been gradually changed following incremental steps. During the transition process, the IT department used a mixture of both imposed and voluntary changes. For instance, taking DocuLive EPR into use, or transforming to electronic referral letters are changes that were imposed on the health care providers. On the other hand, the degree of use of those functionalities is voluntary rather than mandatory. The IT department invites the health care personnel to adopt new work routines (which they see as effective) or to use a new system by emphasising its advantages and benefits, but they preserve local autonomy and do not control whether the health personnel are following those routines. Beside this, the IT department had been encouraging an active involvement and participation of the various health care providers, and after giving them time to try the system, the IT department increased gradually the

[11] Protected-records are medical record with highly private and protected information, and only a limited amount of health care personnel have access to these records.
[12] Examples of the departments that use protected-records are: psychosomatic department, Gender Identity Disorder (GID) among others.
[13] Fødejournal- in Norwegian.
[14] Epicrise refers to a discharge letter from the doctor.

responsibilities that were given to each department. However, the fact that the IT department have no centralized control, makes it incredibly more complex and challenging to conduct changes. As the IT department use an implementation strategy of voluntary changes, patterns of resistance for change (Goffman, 1974) may occur, and it is not always visible on the surface of the overall infrastructure. Several examples can be found as a direct or indirect result of lacking centralized control. One of the departments for instance, bought an in-house system (Laura) without consulting the IT department. This appears to be a bad investment since the IT department is working on a project where they will be removing this system in order to integrate it with another one. The implementation of the EPR for instance, revealed fragmentation in the paper-based records that was not visible before. It became clear that the transition process of merging the record was never fully completed, as there are signs of re-emergence of local sections within the paper record. This fragmentation became visible when the IT department suggested changing the printing routines in cases where patients had been admitted to several departments. It was suggested that in such cases, the last department would have the responsibility to print out the patient's notes that had been written in all the departments. Consequently, those departments who had their own paper-records (sections) could not adopt this new routine, and therefore did not change their work practice.

It is obvious that changing such a large and complex infrastructure as the electronic record takes time, and requires extensive supporting layers, including both technical and non-technical services. So far, the IT department has successfully created an installed base of users of the electronic record. However, the electronic record did not convey dramatic changes within organisation or effectiveness, and the current version of the EPR does not fulfil all the requirements that were set up. The paper-based records were not totally removed, but rather used simultaneously with the Electronic Patient Record (EPR). In this respect, this was not a dramatic change since the two information systems exist side by side. Due to the fact that the existing record system is hybrid combining a mixture of digital and paper-based information, the benefits of a fully digitalized record system have not been realized yet. Moreover, as will become evident later, the actual use of DocuLive EPR is sub-optimal and the initiative to explore and discover additional functions is minimal. Most of the physicians use DocuLive EPR mainly for reading patient information, validating and signing notes. However, additional functions as electronic referral letters, electronic prescriptions, or sick leave notes are not being fully used. Hence, changes within simple information handling and actions can be found, but the overall routines around patient information handling and the work process are approximately as before. The scanning project on the contrary, will enforce radical changes and will have a stronger impact on the existing work practice. Shredding all the paper-based documents that were scanned will increase the transformation towards a digital record, but it will also increase the challenges and the complexities that are implied in such a process. The above mentioned is the leading reason for my motivation to generate the research questions that will be pointed out in the next section.

3. 4 – Research Focus

The overall aim within such a large case, is to look at aspects of complexity emerging from implementation of the Electronic Patient Record. The transition to electronic patient record is a profoundly challenging and complex process, and this reflects on the background of my motivation to conduct this research. The ambition of this thesis is to develop a deeper understanding of the socio-technical aspects of the complexities and challenges associated with such a transition process of the information infrastructure. In addition, to study how to manage a gradual transition from paper to digital patient records, and how to deal with the transition period which implies living with a hybrid system. In this research, I will emphasise the importance of acknowledging the transition period and finding strategies to deal with it.

The overall research aim is addressed by following the implementation and adaptation process of the Electronic Patient Record (EPR). Here, I analyse how the transformation to an EPR effect and change the medical practice, including the work routines around information flow and work processing. In other words, how does the system glide into everyday work routines and with what implications.

I began my fieldwork, employing qualitative research methods. My research is framed by an ethnographic approach, which I believe provides me with a rich insight and in-depth understanding of human, social and organisational aspects. I used a combination of various techniques for collecting and generating my empirical data. In the next chapter, I will elaborate the qualitative methods that I used in the research.

4. Method Chapter

This chapter is divided to three sub-sections. The first sub-section includes an introduction of the case settings, giving the context for the research project. First and foremost I introduce the case settings, including the hospital, and the two departments that the research was conducted at. Thereafter, in the second sub-section, I will focus on the research methods that were used in the fieldwork, as well as discussing core concepts and principles for qualitative research methods. This includes various research perspectives and research approaches, while concentrating on the ethnographic research. I then briefly introduce prospective modes of analysis. Finally, in the last sub-section, I discuss the methods that I used within my field research, including self-reflection on the experience that I gained from conducting the fieldwork. I also use a critical view towards the methods that I used, and include the challenges and weaknesses when using these methods.

4. 1 – Case Settings

4. 1. 1 – Rikshospitalet HF

The field research has been conducted at Rikshospitalet, which is the National hospital. Rikshospitalet (RH) was established in 1826 in Oslo, and is today the second largest hospital in Norway, serving about 1.5 million people. Rikshospitalet has mainly four highly specialised functions: organ transplantation, bone marrow transplantation, specialised heart surgery in children, and specialised neurosurgery. Rikshospitalet is the regional hospital for patients from the Southern Norway Health Region, and it functions as a local hospital for children in Asker and Bærum. Moreover, it offers services to members of the royal family, ministers, and members of the Norwegian Parliament (Storting). In addition, Rikshospitalet functions as a university hospital offering education services, and collaborates closely with the University of Oslo. Rikshospitalet has an annual budget of 2.5 billion NOK (Norwegian kroner), and has 4,000 employees. It has 7,000 rooms, 585 beds, and a patient hotel with 90 beds. Key figures show that 28,000 patients are admitted annually to Rikshospitalet as inpatients, 17,000 patients are given day-treatment, and there are 130,000 outpatient consultations.

4. 1. 2 – The Neurology department

The Neurology department (NEV) is a clinical department at Rikshospitalet. This department has several functions in the regional basis, like for instance in choosing and following up Parkinson patients for transplantation of brain-stimulator. Patients who come to the neurology department often suffer from problems in the Central Nerve System (CNS), which implies that they might have various diagnoses. The department is active in several research areas, such as brain-stroke, the blood-circulation of the brain, epilepsy, chronic pain and disturbance in physical movement (i.e. Parkinson, Dystoni). Due to the fact that the NEV functions as a local hospital within neurology for the hospital in Asker and Bærum, it has a high turnover in the number of patients, and it frequently deals with problems concerning shortage in place (available beds). The

average stay for one patient is often very short; approximately 4-5 days. The NEV department collaborates closely with various hospitals and departments, especially with the Neurosurgery department.

The Neurology department (NEV) is constituted of an out patient clinic, Neuro-physiologic laboratory, and the ward (see figure nr. 4.1). Previously, the ward had two units where one unit was for severe cases (so called intensive unit), and the other was for regular cases. Gradually, these two units were merged into one that includes the two groups of patients. The first group of patients includes regular patients, and the second group is for severe cases where patients need continuous and intensive surveillance (care). Since the second group of patients is very demanding, the nurses rotate between the groups.

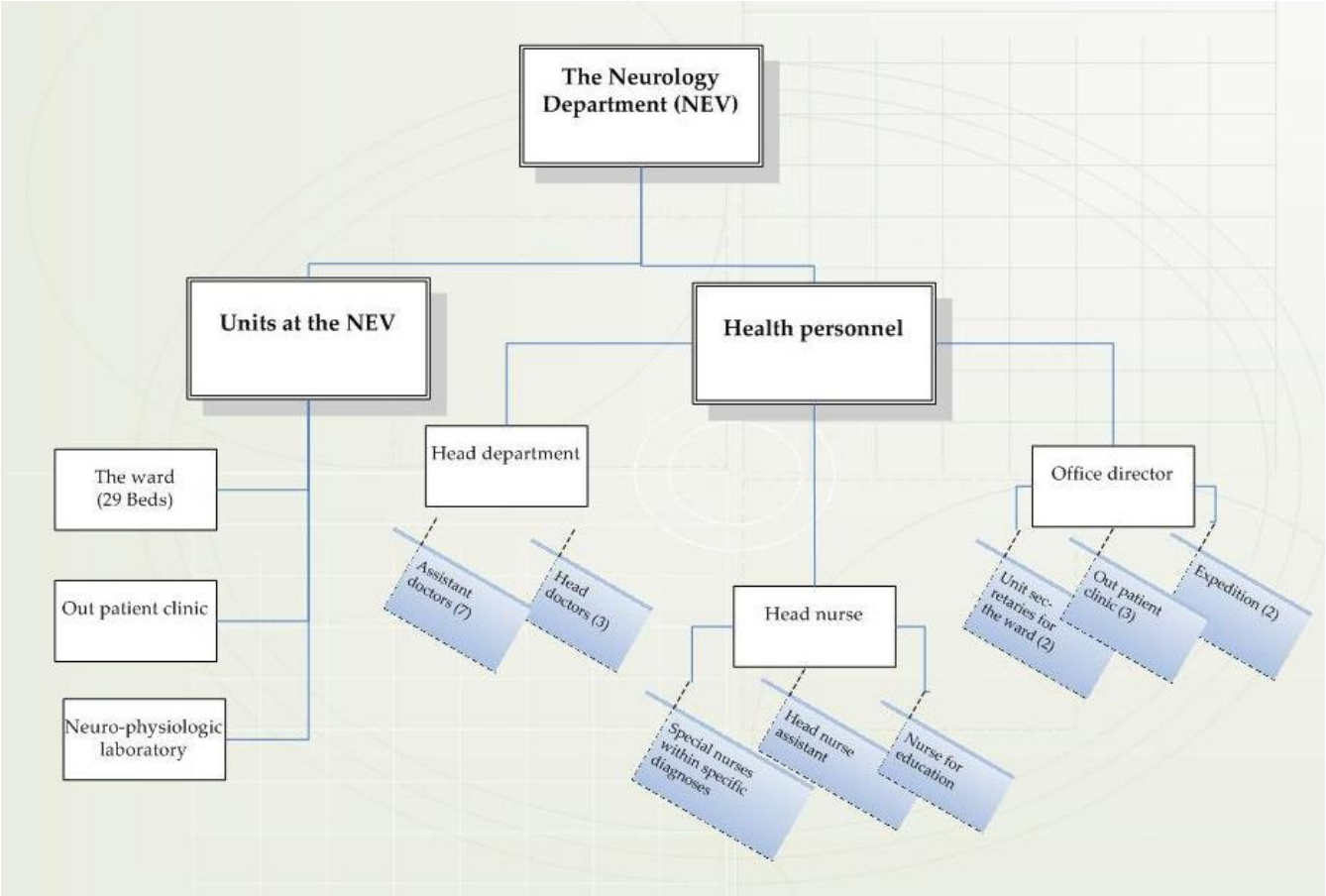

Figure 4.1- The division of the ward at the Neurology department

The medical health personnel is constituted of various occupational groups. This includes in total 8-10 physicians were three of them are head doctors, and seven assistant doctors. There are thirty nurses, and three head nurses. The first head nurse is responsible for the ward, and has the responsibility for the daily work and administrative issues; the second head nurse is responsible for education and research; and the third is responsible for special and specific diagnoses such as Parkinson, NS, epilepsy, and ALS (mortal diagnoses).

In addition, there are seven secretaries at the NEV department. In the outpatient clinic, there are three secretaries that have various responsibilities, like for instance distributing the incoming post and ordering goods. However, their main responsibility is to deal with (organise) the admission of new patients. Two of the secretaries in this group have additional responsibilities; one of them has a part time position for the university, and the second secretary functions also as a patient coordinator (since September 2003). This implies that she is responsible for referral letters, scheduling time for appointments and informing the patients, and pre-ordering complex examinations that must be ordered in advance, such as: CT, MR, EEG, EMG etc.
In the expedition, there are two secretaries that deal with phone calls from patients who were discharged (e.g. control patients). In this respect, they can be seen as the connecting link that intermediates between the doctors and the patients. In addition, they are also responsible for transcribing admission notes. This group of secretaries was established approximately for one year ago.
The last group is constituted of two secretaries who sit in the ward. They are responsible for admitted patients (so called in-patients), as well as the list's patients, meaning the patients that are registered on the list and are expected to be admitted. This includes activities such as, finding the necessary documents and establishing a medical record for the patients that do not have one. In addition to that, they organise the ordering and distribution of laboratory examinations and results.

In sum, the secretaries at the outpatient clinic and those at the expedition have in many ways the same work practice when it has to do with writing activities for patients that are already admitted to the department. This shows that there are no clear borders between the responsibilities that the various occupational groups have. The division of is a highly dynamic process which continuously changes depending on the conditions and context.

4. 1. 3 – The Neurosurgery department

The Neurosurgery department (NKI) is a clinical department at Rikshospitalet, that deals mainly with diagnose and treatment of illnesses, deformity and injuries in the Central Nervous System (CNS). The Neurosurgery department collaborates closely with various hospitals and departments, especially with the Neurology department. The characteristics of this department are that it is a large department, and that they often deal with emergency cases; approximately half of all the admissions are emergency. Consequently, the environment is frequently often hectic and marked by a continuous improvisation to cope with unplanned events. The average stay for one patient is very short; approximately 5 days.

The NKI department has approximately 60 beds, and is divided to three units where two are for adults (unit nr. 1 and unit nr. 2) and one unit for children (see figure nr. 4.2). Each of the adult units is divided to two groups and so are the nurses; one group for regular patients and one for severe cases where patients demand continuous and intensive control. The difference between the two adult units is that unit nr. 1 has a small group of surveillance patients (4 patients), while unit nr. 2 can give a treatment to 10 surveillance patients.

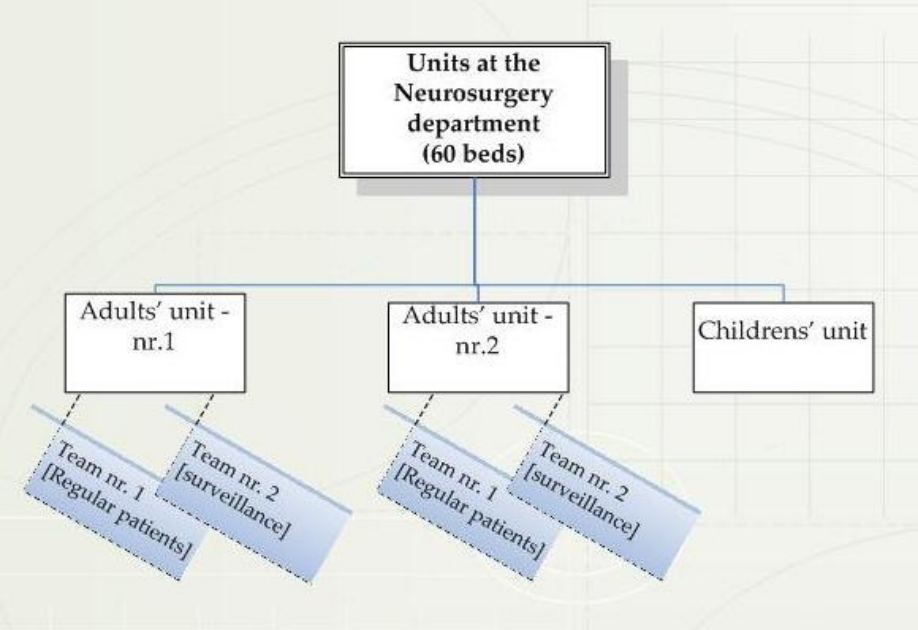

Figure 4.2- Units at the Neurosurgery department

The medical health personnel is constituted of various occupational groups. This includes in total fourteen physicians and ten assistant doctors. There are twenty-nine nurses in the adult unit nr. 1, and forty-three nurses in the adult unit nr. 2. In addition, there are three head nurses, each responsible for one unit.

4. 2 – Qualitative Research Methods

Conducting this research provided me the possibility to gain knowledge concerning the medical care, as well as using qualitative research methods. Hence in this sub-section, I would like to introduce the qualitative research methods that I used in order to be able to answer some of the research questions that were previously introduced.

Qualitative research methods were originally developed in the social sciences. The research topic and questions being addressed are the reason for my motivation in choosing qualitative research methods. These methods have a specific strength in helping to understand people as well as social and cultural phenomena (Avison, Lau, Myers and Nielsen, 1999). Qualitative research methods are used among other methods, for describing what is happening in the settings, meaning the participant's views of processes and collecting subjective accounts of phenomena. Thereafter, a qualitative approach is applied for analysis of the data, including finding connections and relationships, the influence of the context, and different perspectives toward phenomena. I would like to refer to three distinguishing features of qualitative research. The first one is that it is concerned with exploring and interpreting social phenomena, in terms of meanings that people attach to their subjective understanding and experiences of the social world. In other words, the researcher tries to understand how people make sense of their world. The second key strength of qualitative research is that it studies people in their own territory and in their natural settings. The last feature that I would like to mention is that it often employs several different methods, including passive and active participation, interviews

and informal chatting, analysis of documents etc[15]. Since the 1990's, there has been a shift in Information System (IS) research from a technical focus to managerial and, to more organisational issues. In other words, an increasing interest in "the relationship between IS and organisation as a whole" (Myers and Avison, 2002, p. 3).

A research study typically has an underlying epistemology, which influences and guides the research, and determines how the phenomenon being studied will be disclosed (Myers and Avison, 2002, p. 77). Epistemology refers to the philosophical assumptions and criteria for constructing and obtaining knowledge. Based on the underlying epistemological shifts, Orlikowski and Baroudi (1991) describe three paradigms: positivist, interpretive and critical (Orlikowski and Baroudi, 1991, pp. 1-28). Each of these has a diversity of assumptions that underlie them. However, it is worth mentioning that even though there is a philosophical distinction between these epistemologies, these are not always so clear in practice. A survey conducted by Orlikowski and Baroudi (1991) shows that much of the IS research reflects a positivistic perspective. They argue that the dominance of positivism has implications not only on the kinds of aspects of IS phenomena we have studied and the way we have studied them, but also for the practice of the IS work (Myers and Avison, 2002, p. 57).

In the next sub-section, I will briefly introduce the core concepts and principles for the different philosophical perspectives. I find it natural to focus on the interpretive perspective since it is more related to my research study where I, the researcher, focus on understanding and interpreting daily occurrences as well as the meanings that actors assign to phenomena. In other words, I am not tying to control and predict what happens but rather to understand it.

4. 2. 1 – Philosophical perspectives

The Positivist Perspective

When positivism is being used as the underlying orientation, the researcher assumes that reality is objectively given, and that it can be described by measurable properties independent of the researcher and the instruments that are being used. Generally speaking, one can say that in these studies the researcher attempts to test theory, and to increase the prediction of phenomena.

The Critical Perspective

Using the critical orientation, researchers assume that social reality is historically constituted and that people produce and reproduce it. However, critical researchers recognize the constrains that are posed for people when acting to change their social and economic circumstances. These constrains can appear in forms of social, cultural and political domination. Another vignette of the critical perspective is the intentions of agenda empowerment or awareness raising.

The Interpretive Perspective

Currently, interpretive methods have received increasing attention and become more acceptable in the IS discipline (e.g. Klein and Myers, 1999; Walsham, 1993; Walsham,

[15] http://www.bmjpg.com/qrhc/chapter1.html- Qualitative Research in Health Care. Second Edition. Edited by Catherine Pope and Nicholas Mays (last assessed: 10.03.2003)

1995). One of the interpretive research methods that exist is ethnography, and conducting field studies helps generating interpretive knowledge since they study actors within their social setting. Interpretive research assumes that "the reality is not given" (Myers and Avison, 2002, p. 65), but rather constructed and reinforced by social actors. Hence, it focuses the attention on understanding and interpreting daily occurrences and social structures as well as the meaning actors assign to phenomena. As opposed to the positivistic approach, the interpretive approach has a non-deterministic perspective where the researcher is not trying to control and predict what happened, but rather to understand it. Rosen points out that "understanding social process involved getting inside the world of those generating it" (Rosen 1991 in Myers and Avison, 2002, p. 65). The point of departure of interpretative field studies is to produce "an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context" (Walsham, 1993, pp. 4-5). A basic premise of this research is that organisations are not static, and that the interrelation/relationship between people, organisations and technology is continuously changing and dynamic

I find the interpretive perspective to be the most appropriate for my research framework. Using such a perspective asserts that through social constructions such as language and shared meanings I can gain access to reality. Yet, as Morgan points out, it is important to be aware of the fact that "social phenomena may have many potential ways of revealing themselves and the way they are realized in practice depends on the mode of engagement adopted by the researcher" (Myers and Avison, 2002, p. 77). In other words, it depends on which lens the researcher uses to see the world.

The interpretive research philosophy, however, has been criticized for not addressing structural conflicts within society and organisations, and ignoring contradictions, meaning it "cannot account for situations where participants' accounts for action and intentions are inconsistent with their actual behavior". In addition, it neglects to explain "how a particular social order came to be what it is, and how it is likely to vary over time", meaning, historical change (Bernstein et al., 1987 in Myers and Avison, 2002, p. 70).

4. 2. 2 – Ethnographic research

Qualitative research methods give another insight concerning questions in term of "who", "what", "where", "how" and "why". Yin (1994) argues that research methods "provide an important clue regarding the most relevant strategy to be used" (p. 20). The case setting influences the choice of a relevant and rigorous research approach. This research was part of my Masters project and lasted therefore over a period of time. Another issue that must be taken into account when considering an appropriate research approach is the fact that Rikshospitalet is a large organisation which includes various departments and occupational groups. This implies higher complexity, greater imprecision, and the possibility of different interpretations of the same phenomena.

A research approach is a strategy of inquiry which moves from the underlying philosophical assumptions to research design and data collection. The way in which the researcher collects data is influenced by the choice of research approach. There are various approaches, like for instance: action research, case study, grounded theory, and ethnography. The essential characteristics of Action Research (AR) are that it is future

oriented and has a collaborative aspect. In addition to contributing to the system development, it has a focus on the situational contextual problem and solution. AR is concerned with improving the quality of an organisation and its performance. The case study research approach is a common approach used in IS research. Yin (1994) defines a case study as follows: "A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context especially when the boundaries between phenomenon and context are not clearly evident" (p. 13). The case study approach is mainly appropriate to the form of questions in term of "how" and "why" for capturing the domain of interest (Yin, 1994, p. 21). Grounded theory is a research method that seeks to develop theory that is grounded in a data systematically gathered and analysed. The distinguishing feature of grounded theory, however, is its specific approach to theory development. It suggests that there should be a continuous interplay between data collection and analysis.
In the following sub-sections, I will present the central characteristics of the ethnographic research approach since I believe that it reflects on the nature of my research.

Ethnographic research comes from the disciplines of the social science where ethnographers immerse themselves in the lives of the social group under study (Lewis, 1985, p. 380) and seek to place the phenomena studied in their social context. The reason for choosing ethnographic research approach is that I believe it can improve the understanding of technology use in the medical practice, and that it has the ability to make medical settings visible and to produce detailed descriptions of the medical practice. The main difference between case study and ethnographic research is the extent to which the researcher immerses herself or himself. The primary sources of data in a case study may be interviews and documentary materials without using participant observation. The distinguishing feature of ethnography is that the researcher spends a significant amount of time in the field. Hence, in such study, data sources are supplemented by empirical data that is collected through participant observation including reflection over experience from the fieldwork. When spending an extended period of time in the field, the ethnographer sees what people do in practice as well as what they say they do. In other words,

> "*Ethnography argues for understanding the situatedness of individual activities and of the wider work setting, highlighting the interdependencies between activities, and stressing the 'practical participation' of individuals in the collaborative achievement of work*" (Hartswood, Procter, Rouncefield, Slack, Soutter and Voss, 2003, p. 378).

Spending extensive amount of time in the field was important for me, as I believe that I learned a lot from the informal discussions and conversations that often were tied to evolving customs and practices, which are not easily documented. Harvey and Myers assert that: "Knowledge of what happens in the field can provide vital information to challenge and explore some of the assumptions gained from a mainly experimental-based body of knowledge" (Myers and Avison, 2002, p. 178). Moreover, the ethnographer is provided by a richer insight and in-depth understanding of the human, social and organisational aspects (Myers and Avison, 2002, p. 4). In sum, the ethnographic eye can help reveal the inner workings of development of information infrastructures, as it uncovers hidden assumptions and narrative structure, as well as values and biases that are inherent in various tools (e.g., boundary objects and standards)(Star, 2002). Recently, ethnography has become more widely used in the study of IS in organisations, from the

study of the development of IS (Hughes, Randall and Shapiro, 1992, p. 115-123) to the study of aspects of information technology management. One of the main weaknesses of ethnographic research is that it is time consuming. It takes a long time to conduct the fieldwork, and a longer time to write and analyse the empirical material (Myers, 1999).

4. 2. 3 – Modes of analysis

Modes of analysis are different approaches to gathering, analysing and interpreting qualitative empirical data. The common thread is that they are concerned primarily with textual analysis, which can be verbal or written. There are many different modes of analysis, but I choose to briefly mention the hermeneutics.

Using hermeneutics as a specific mode of analysis suggests a way of understanding textual data. Hermeneutics is first and foremost concerned with understanding an organisation through interpretation of the meaning of oral or written text-analog. This implies that he/she attempts to make sense of unclear or contradictory text or text-analogue, and "aims to bring to light an underlying coherence or sense" (Taylor, 1976, p. 153). The essential idea of hermeneutic circle is the dialectic between the understanding of the text as a whole and the interpretation of its parts, where anticipated explanations guide description. "The movement of understanding 'is constantly from the whole to the part and back to the whole" (Gadamer, 1976a, p.117). It implies that we have expectation of meaning based on the context of what happened before. Hermeneutics is recognized framework "in particular when looking at organisational culture, and has been applied to the analysis of socio-technical interactions" (Barley 1986, in Myers and Avison, 2002, p. 176).

4. 3 – Fieldwork

Each research approach employs various methods for collecting and generating empirical data. In this section, I will introduce the methods that I employed to my fieldwork. I chose to use a combination of several techniques for collecting and generating my empirical data, including interviews, and observational techniques such as participant and passive observation. I used various written data sources including reports, memos, newspaper articles and so forth. In addition, I have been collecting artefacts and documents from different resources, such as white papers distributed inside the IT department, Siemens product papers, and web press releases from Siemens. I have been reading mail exchanges, documents that I received from personnel at the hospital and from the IT department, and of course using the resources that are available in the library and on the Internet, including information from the Norwegian government informing about changes within the health care sector. All these various resources gave me a textual representation of the EPR project, the hospital and the various departments. I used various tools, such as a field notes template (for in-progress reporting), visual representations (photos, graphics, slides), mapping activities and information flow. In addition, I collected samples of the many different forms that are being used in the different departments.

As soon as I started working on my Masters project, I chose to mainly concentrate on the fieldwork. Before going to the field, I signed on the hospitals' secrecy statement (see

Appendix A), and received an ID card from the IT department. As a starting point, I was seeking to understand the nature of reality and knowledge in the hospital. In order to have a taste and flavour of the medical world, I joined two of the members of the EPR research team (Grisot and Iacucci)[16], and passively participated in six interviews. Doing that, I became familiar with some basic and important concepts, and acquired knowledge about the various forms that are being used and the medical language that provided a common ground. In addition, knowing the historical background of the EPR project helped me to understand the present situation. This way, I felt that I was equipped to learn more about the work practices that the various personnel have, the information flow, and means of communication. When collecting the data, I fully transcribed all the audio-recorded interviews, and constantly documented notes from the observations, and agendas from the meetings. While documenting the fieldwork and analysing the data, I discovered the topics that seem to be interesting for further and deeper investigation. In this respect, the fieldwork helped me to some extent, to find and frame my domain of interest.

In total, I conducted in nineteen open-ended interviews and fourteen observation sessions (resulting in thirty hours), and participated in five DocuLive training courses. That is in addition to the weekly meetings that the EPR research team has, and other informal meetings with some of my research colleagues. The fieldwork was conducted over three phases (see figure nr. 4.3). The first phase of the fieldwork started at the end of October 2002, on a small scale. Most of the fieldwork was conducted in the Neurology department. As a starting point, I chose to concentrate on the adaptation and integration process of DocuLive EPR, on order to highlight the first impression of the system. The second phase took place during January – March 2003. In this phase, a second round of interviews and observations were conducted at both the Neurology and Neurosurgery department. The general aim was to acquire deeper knowledge about the medical work practice, as well as to try to identify changes that appeared as a result of the introduction of the EPR. The third phase was conducted during May – October 2003. The aim in this phase was to try to draw a broader picture of the situation after using the EPR at the neurology department for approximately one year, and in the Neurosurgery for more than one and a half years.
The following sub-sections will include discussion of two main methods that I used within the fieldwork: in-depth semi-structured interviews and observation of the local work practice. In addition, I will include an introspective and reflective account of my experience.

[16] Miria Grisot and Edoardo Iacucci are two PhD students that are members of the EPR research team within system development field at the Department of Informatics, University of Oslo. The research team follows the development and implementation process of EPR at Rikshospitalet, and collaborates with the IT department of the hospital. Among the various activities, the team gather weekly for interdisciplinary meetings together with staff from the IT department, and other researchers.

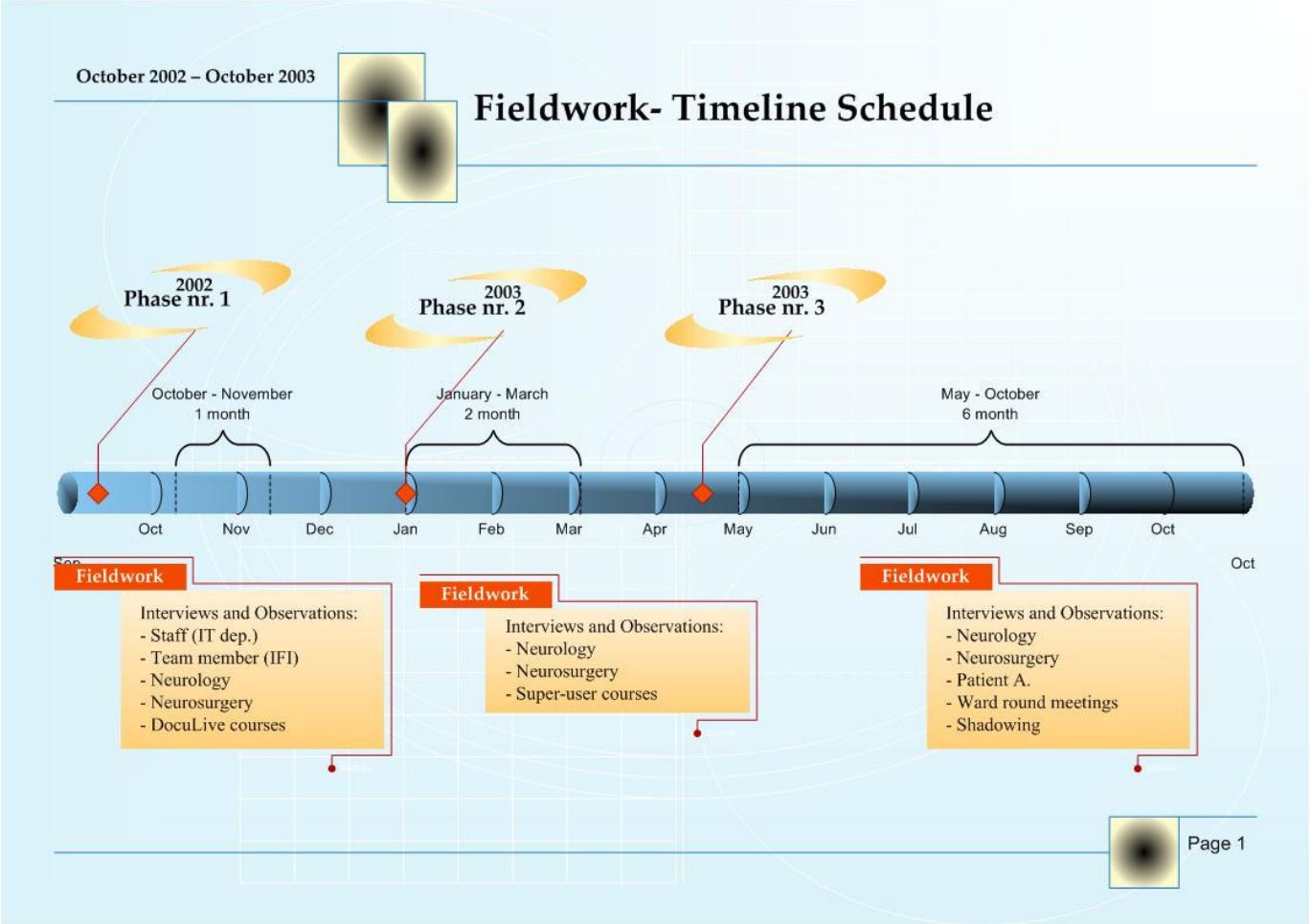

Figure 4.3 – Fieldwork- Timeline Schedule

4. 3. 1 – Interviews

I combined two types of interviews, in-depth interviews (less structured, but cover only few issues in greater detail), and semi-structured interviews (loose structure consisting of open-ended questions that define the issues to be explored). I conducted nineteen in-depth semi-structured interviews lasting from half an hour to three hours (see Appendix B for a list of the field research). The interviews were conducted with the different occupational groups, meaning the physicians, nurses, secretaries, the staff working with the records archive, and the staff from the IT department. That is in order to reflect on the multiple perspectives that various groups have. Out of the nineteen interviews, six of them were conducted with physicians, six with nurses, and four interviews with secretaries. Some people were interviewed twice. In total, ten interviews were conducted with the health care personnel from the Neurology department, six interviews with the health care personnel from the Neurosurgery department, and three interviews with other personnel.

Each interview had its own unique character, but in general I can say that the main aim with the interviews was discovering topics such as: the different work practices that the various occupational groups have, and the information flow; looking at the various software used in the different departments; discussing DocuLive; and means of communication. I wrote a list of core questions that defined the issues that I wanted to

cover, based on my objectives of the research, and used it as a type of template for the interviews (find attached a template of questions in Appendix C).

Another issue that I started to be interested in, refers to the methodological question: on what base should the researcher choose the interviewees? There are both practical and theoretical considerations for this. The practical consideration depends on the access that the researcher gets, and the way contact is established with people. One way is to contact people by links. For instance, the researcher can start by establishing contact with the head of the department, the office director, or the head nurse, in order to introduce the research and the purpose. Consequently, the researcher can ask if they could recommend potential interviewees (people whom I could contact and who will be interested in an interview). Then from there, the researcher can interview the following person, for instance a secretary, and ask if she or he knows about any doctor who has time for an interview. This way, the researcher can build a network of communication with the various personnel. Another useful thing that I learned is to attend meetings or DocuLive courses that gave me the opportunity to meet several people at the same time. Contacting personnel at the hospital can also be done by simply taking the telephone book (or looking in the hospital's homepage in the internet) and phone them. However, in this case, the researcher does not know much about the interviewee (expect from his/her formal position). The theoretical questions about how to choose the interviewees are concerned with the type of information that is received from the interview. Another consideration that should be taken into account, is how many people to interview; after all, each interview is unique and each interviewee is reflecting about his/her personal experience. Therefore, it is essential to frame the field research in advance (or as soon as possible) and decide which departments or occupational groups will be covered in the research. Collecting extensive amount of data can in one way be useless if the researcher does not have the time to analyse it. At this stage, the researcher has the possibility to find the patterns of things in the material. Yet, there are two temptations that are common: generalizing, and quoting people while neglecting the context. Hodden expresses these problems in the following way: "different types of text have to be understood in the contexts of their conditions of production and reading…once transformed into a written text, the gap between the 'author' and the 'reader' widens and the possibility of multiple reinterpretations increases. The text can 'say' many different things in different contexts" (Hodden, in Denzin and Lincoln 1994). The researcher should be careful and aware of the fact that as soon as quotes are written, they become very strong arguments. Therefore it is essential to always supplement the complete context to the quote.

Qualitative interviewing is a flexible and powerful tool which provide a relatively quick way of gathering information, but it also has challenges and weaknesses. I learned that interviews can be misleading if not supplemented by other methods and means of understanding. The researcher discovers that "What people say is often very different from what people do [...] thus a full sociological analysis cannot be restricted to interview data. It must also consider the material traces" (Hodden, in Denzin and Lincoln 1994 , p. 395). People are not always aware of what they do, therefore observing or asking questions in different ways might help. People have different perspectives, and it can be instructive to be aware of this aspect. As I was trying to build the case of the Parkinsons patient, which will be outlined in chapter 5, I experience many of these complexities and

challenges. I conducted multiple interviews and observations concerning the work practice and procedure that are involved in such case, trying to put together multiple viewpoints from heterogeneous actors, while striving for the complete picture. Several times, when analysing the empirical data, I found that various viewpoints were contradicting, and that several actions and intentions were inconsistent with the actual behaviour. Sometimes, I even found inconsistent information about the same trajectory. An example is from when I wanted to study how the NEV department apply for a Parkinson operation at the NKI department (including the actors that are involved, communication channels, and the information flow). In two separate interviews, both the patient coordinator and the assistant doctor told me that a referral letter is being used, as in other cases of transferring patients. However, when I interviewed one of the Parkinsons surgeons, I was told that in such cases, the epicrise is being used as a referral letter. I believe that one of the reasons for this inconsistency is that some of the health care providers knows about their own work practice, but has imprecise knowledge (partly based on assumptions) about the articulation work of other practices and the overall process. I noticed that some of the health care providers do not know how much articulation work is embedded in one trajectory and how much effort is needed to complete an apparently simple activity.

While conducting my fieldwork in the hospital, I learned that I had to deal with the "just-in-time oriented setting". This implies that emergency cases or other unexpected contingence may often arise and cause interruptions, delay or cancellation of the interview. In these situations, I would usually try to contact someone else, or to use my time for an observation session. Another interesting issue is that I had to be prepared to follow an opportunistic research where I had to "jump" from one interview into another. This implies that I always had to be prepared with questions, and be able to discuss the domain of interest. Several times, I had an interview with one person, and when asking about other potential interviewees, I was taken almost immediately to the next person. The problem in these situations is that the first interviewee often joined me and was present in the second interview, something that affects the overall atmosphere. For instance, I faced a situation where I first interviewed a secretary that had a negative attitude towards DocuLive EPR. Thereafter, I interviewed a doctor who seemed to have a positive attitude towards the system. However, during the interview, the secretary was very dominant and interrupted several times; in a way I felt that she drew the interview to another direction. I have learned that getting around the problem of impromptu interviews is not so simple in the hospital settings. I could ask to postpone the second interview, but this way I could risk losing the interview, as the personnel are very busy and difficult to contact.

I have learned that it is advisable to write the notes from the interviews as soon as possible after the sessions. That is because "the quality of the notes diminishes rapidly with the passage of time. Without the discipline of daily writing, the observation will fade from memory, and the ethnography will all too easily become incoherent and muddled" (Schatzman and Strauss, 1973, p. 179).

The way the ethnographer stores the data from the fieldwork affects efficient retrieval. Organising and reorganising the data in terms of categories is essential and it can be done in various ways. Assigning the data to categories is one way; another is using an analytic

index where each data segment is indexed under a developing set of headings (Schatzman and Strauss, 1973, p. 195). While conducting my fieldwork, I gradually indexed my empirical data, and organised it following analytical categories and themes. The descriptive raw material from the entire fieldwork resulted in 168 pages of documentation.

All the interviews were audio-recorded with permission from the research informants that were interviewed, as I gave them assurance about confidentiality. Audio-recording interviews provided me the ability to have eye contact with the interviewees, and to follow the body language. I have noticed that taking notes at the time of the interview attracts the interviewee's attention and interfere the process of interviewing, as the interviewee often waited until I finished writing. Another major advantage is the possibility to listen to the interview several times, allowing a better analysis of the text. However, for an ethnographer who wishes to explore conflicting voices, differing and interacting interpretations, it is advisable to remember that there are many areas which are hidden from language (Schatzman and Strauss, 1973). For instance, "artefacts that are produced so as to transform, materially, socially, and ideologically" (Schatzman and Strauss, 1973) that create a feeling of common identity, or confer authority. Other cultural artefacts and non-verbal features can be, for instance, the physical setting, like the decoration of the room. Usually before entering an interviewee's office, I look around the office; scan the piles of papers that are placed on the table, at the books and covers that are on the shelves, the various forms that are hanging on the walls, and other artefacts. These were important for the interpretation of social experience.

All the audio-recorded interviews were fully transcribed, and this gave me the possibility to go back to the interaction logs, when neglected or overlooked issues become important. The disadvantage with recording interviews is that it is an immensely time consuming process, as each hour interview can take six or seven hours to transcribe[17]. An alternative is to index and summarize much of the audiotape, while transcribing only what seems essential (Schatzman and Strauss, 1973, p. 187).

The last issue that I would like to mention is the language. I chose to conduct most of the interviews in Norwegian because I felt that the interviewees were more comfortable speaking their own language. Three interviews were conducted in Arabic, as this was the native language of these interviewees. When transcribing the interviews, I translated most of them to English and did my best to preserve the original meaning. Some of the words that I identified as keywords were left in Norwegian.

4. 3. 2 – Observation sessions

The other method that I used in the fieldwork was conducting observations. Hence, instead of asking health care providers about their work practice, I systematically watched them and observed their everyday behaviours and interactions. In total, I carried out fourteen sessions of observation of the medical staff, all together lasting thirty nine hours observation time. Three observation sessions took place in the Neurosurgery department, eight sessions at the neurology department, and two sessions at the

[17] http://www.bmjpg.com/qrhc/chapter1.html- Qualitative Research in Health Care. Second Edition. Edited by Catherine Pope and Nicholas Mays (last assessed: 10.03.2003)

Orthopaedic department. The observation sessions were conducted in various places in order to gain a deeper knowledge about the heterogeneous medical practice of the various work professions. Some of these places are: the wards, secretaries' offices, expeditions, physicians' offices and so forth. Depending on the context and possibilities, I changed between playing an active and fairly passive role during the observation sessions. While conducting the interviews, notes were taken concerning various issues as key events, information that was exchanged, artefacts that were used etc. Thereafter, the descriptive raw material was indexed into categories and analysed.

I have noticed that observing the local work practice allowed me to see more details that I had not previously considered to be important. While conducting the observation sessions, I faced situations where I had to adopt different roles according to the type of setting. In two observations, I went together with one of the staff from the IT department, in order to observe him providing support in the field during the first week of the implementation of DocuLive EPR. In spite of the fact that I presented myself as a researcher, I experienced the pull and conflict between my role as a research and the perception of me as a member of the technical support group. When the personnel saw me as someone who works in the IT department, I felt that I was put in a different role than a researcher. For instance, I faced multiple situations where the health personnel asked me to repair their printers or to assist them with other technical problems. I found it important to clarifying my role as a research, and my aim which was to reveal and observe the complexities that arose when DocuLive EPR was installed in the different departments. Once, one of the nurses smiled to me and said in a humoristic tone: "*So, you are writing your Masters thesis on our problems"?* Clarifying my role was important for me as I believed that I could gain more credibility among the health personnel since I was an objective "outsider". As a researcher, I did not want to be seen as an actor who belongs (or supports) one party or another. In the beginning for instance, I felt that some of the health personnel did not trust me as they often said that everything was functioning well, and that they did not face any complexities during the implementation process of DocuLive EPR. This was not coherent with the information that I received from other personnel. After a while, my presence did not stimulate their behaviour and actions any more, and the atmosphere was more relaxed.

I participated in three DocuLive training courses as well as two super-user courses (eighteen and a half hours) that were provided for the physicians, nurses and secretaries from the Neurology and the Neurosurgery department. During these training courses, I learned not only about DocuLive, but also about how the personnel interact with each other and about their medical practice. In addition to that, I learned about the constrains that were faced, and their attitude and hopes towards the EPR project, based on the questions that were asked. I saw this opportunity as a window onto the nurses' world. I joined them for coffee and lunch breaks, so that we could talk in informal settings. They were very friendly and easy to talk to. When I came to the observation sessions, I was surprised to see that many of them remembered me from the courses, and asked me about my research. I felt they treated me as if I was "one of them", and as if a sense of trust was gradually built between us as I gradually spent extensive time in the field. When I shared my empirical data with some of the staff at the IT department, I was told that it seemed like some of the health personnel trusted me as I had so much information from the interviewees.

I participated in two pre-ward morning meetings with physicians and nurses, as well as other meetings at Rikshospitalet. I also conducted a “shadowing” sessions where I followed a nurse through her workday. In addition, I took photographs to highlight work situation of particular interest. Part of my work was to provide the IT department at the hospital with feedback from the users, the health care providers, concerning the development process of the EPR.

In sum, I learned that observing can be a powerful tool to get insight into various aspects and perspectives. When using this method, the researcher does not need to ask the actors what they do (since this is already being observed), but rather concentrate on *how* and *when* they do things. Observing the on-duty room for instance, can be profoundly interesting as it is often crowded and the atmosphere is hectic. Physicians and nurses pass through all the time asking questions, giving advices or having discussions. Using this method, I gained a better insight into the local workplace setting and culture.

5. Empirical Material

In this chapter I would like to present my empirical material, which will be used as the basis for the analysis chapter. I begin by describing the implementation process of DocuLive EPR, and the fledging infrastructure that was gradually developed. I will divide the process into three phases drawing upon my fieldwork. Since the EPR is part of a larger infrastructure, I cannot discuss this without viewing it in relation to the rest of the infrastructure that the EPR is part of (i.e. work practices, artifact's roles and properties). Therefore, I will introduce a case study of a Parkinsons patient, which sheds light on the complex work practice. Then, I will describe a small change that was conducted in the infrastructure of the EPR. Here I refer to the transformation process to electronic internal referral letters. Finally, I will briefly introduce the scanning project, which is a complex and large change that will effect the entire infrastructure.

5. 1 – The Implementation Process of DocuLive EPR

In this section I will describe the implementation process of DocuLive EPR in the neurology department (NEV) and the neurosurgery department (NKI). I choose to divide the description of the process into three phases based on my fieldwork that was conducted in three periods, and will describe the distinctive features of each phase First I will introduce the development and implementation phase, drawing upon the fieldwork that was conducted during the first month of using DocuLive. Most of the empirical data during this phase is taken from the neurology department (NEV), due to the fact that the neurosurgery department (NKI) started using DocuLive before I began my fieldwork (in August 2002). Subsequently, I will describe the second phase, which includes the modifications and customizations that were conducted in the system, and its impact on the situated work practices. The description here is based on a fieldwork that was conducted for a period of two months. Finally, I will describe the distinguishing features identified during the last phase, drawing upon a fieldwork that was conducted during a period of six months. The description in the last two phases is based on empirical material that was collected from the NEV and NKI, as well as various conversations with the staff (the support team) from the IT department. In sum, my objectives in this section is to introduce the gradual transition to electronic patient record in two departments, as well as to illustrate how this was handled and managed by the IT department.

5. 1. 1 – The development and implementation phase

The introduction phase of DocuLive EPR, began by establishing contact between the IT department and the head of the neurology department and the office director. The project manager and the system administrator from the IT department introduced the EPR project, and informed them about the first information meeting that was for all the personnel in the department. In this information meeting, the staff from the IT department presented the new software by showing a demo version of DocuLive EPR, as well as providing general information about the electronic patient record. In addition, they presented a strategy plan for the development and implementation process of the project, as well as a plan for the tasks that will be done before the final start-up (meaning before the personnel start using DocuLive). Thereafter, contact personnel (so called user-

contacts) from each occupation group were chosen to represent each occupational group, including one doctor, a nurse, and a secretary. They were given the responsibility to report to the IT department on complexities and problems that occurred when using DocuLive EPR. A third meeting was established with the contact personnel that were chosen during the last information meeting. Several people from the IT department participated in this meeting, where they discussed the introduction process of DocuLive EPR, and the responsibilities of the user-contacts. The staff from the IT department, whom is responsible for the nurses, conducted a meeting only with the nurses. A short introduction of the adaptation process of DocuLive was given, followed mainly by explanations of how the nurses' work routines will change and what are the new routines that should be adopted. The nurses at the neurology department were given a document that contains a stepwise explanation of the work practice that the nurse should follow in two cases: admission (using the G2 form[18]), and summery (the A5 form[19]). These cases reflect on the situations where nurses were required to use DocuLive EPR.
At this phase, it was the department's responsibility to conduct interdepartmental meeting for their personnel, if there was a need for that. The staff from the IT department usually participated in these internal meetings in order to answer questions that arose. This was the last meeting before the start-up phase where the department started using DocuLive in their everyday work-practice.

Between the meeting with the contact people and the one with the nurses, the healthcare personnel from the department were sent to one-day DocuLive course in order to learn how to use the program. The personnel were divided into three, based on the three occupational groups (the physician, the nurses, and the secretaries). Each group attended a different day for the course. The courses were generally the same, and included an introduction about basic functions in DocuLive, like for instance: logging in and finding a patient in the electronic record, retrieving information and writing notes, and so forth. However, the courses were adapted and customized to the different needs that each occupational group had, covering the functions that were relevant for their everyday work practice. The courses for the nurses and secretaries were five and a half hours long, while the courses for the physicians were cut to merely two hours. Moreover, the courses for the physicians were conducted at the hospital (and not in the IT department), so that it will be more convenient for the physicians. The night shift personnel had special short courses in the evenings, which they could attend before going on duty (to work). After the courses, the healthcare personnel received a document that included a summary of the basic functions in DocuLive, and they were informed about the possibility to train and explore DocuLive on their own using a test-database that contained test patients.

While the health care personnel attended DocuLive courses, the HelpDesk team from the IT department , installed DocuLive in the neurology department. In addition, they installed new hardware (including new PC's, larger memory cards (RAM), new printers

[18] G2 is the Admission note ("Innkomstjournal"): It includes a statement about the patient at admission and reason for hospitalization as detailed assessment according to ten specified functional areas of human functioning.

[19] A5 is the Nursing discharge summary ("Sykepleiesammenfatning til ekstern sykepleietjeneste"): It includes a resume of solved problems during hospitalization and specification of identified problems for further follow-up by nurses in other institutions or levels of care at discharge (see Appendix D.5).

etc.) in places where the technological devices were too old. In the middle of October 2002, the neurology department received five new PC's, two screens and several printers.

On the 22nd of October 2002, the physicians and the secretaries in the neurology department started using DocuLive in their daily work practice. The nurses joined them a week later, in order to facilitate the gradual implementation of the transition. During the first week of using DocuLive, staff from the IT department provided user-support in the field. The support team walked around in the department, answered questions and gave the personnel immediate assistance. This means that the health personnel could ask questions at almost any time without interrupting their work. In addition, the support-team from the IT department was equipped with a personal pager, which provided the health personnel the possibility to page (call) the support team in case problems were faced. When I asked one of the support-team from the IT department what was her opinion about the support in the field, she told me the following:

> H: "*In my opinion, our* [the support team's] *presence in the field during the first week was paramount"…"It was like the placebo effect*[20]*: as soon as they saw us, they felt more confident"*.

After the first week, the health personnel who faced problems could call the user-support team (brukerstøtte) and receive support via the telephone (in case the problem could not be solved through the telephone, one of the support team would come to the department).

During the first month of using DocuLive, there were various challenges and complexities that were faced in the neurology department. For instance, problems attributed to the physicians' attitude, including lack of interest and cooperation. It is worth to mention that the percentage of the physicians who attend the course was not high, and this caused to increased frustration and constrains among some of the physicians. When comparing between the various occupational groups, the secretaries could be identified as the "easiest" user-group to deal with. On the contrary, some of the nurses and physicians suffered from lack of basic and elementary knowledge with computers, and this caused to increased frustrations.

One of the head nurses expressed her opinion in the following way:

> E: "*In the beginning, some of them* [the nurses] *thought it was very difficult, and asked whether it was necessary to start using DocuLive? They claimed that they would prefer to spend more time with their patients, rather than sitting in front of the computer. But, after attending the* [DocuLive] *course, they had a more positive attitude towards the idea of using DocuLive"…"Some of the nurses faced big problems, since they do not have such a rich knowledge and experience with using computers"…"But in general, I see that they spend much more time sitting in front of the computer"*.

The lack of experience with computers became visible in the observation sessions when I joined the support-team during the first week. I observed for instance several nurses who first wrote the admission-note on a paper-draft, and then transcribed it into DocuLive, instead of typing it directly into the computer. Deleting for instance a paragraph, was done by deleting each letter in the sentences, instead of marking the whole paragraph with the mouse and pressing on the "backspace" button. In addition, I noticed that there

[20] The placebo effect refers to an observed improvement in health that is not attributed to a medication or treatment. Sugar pills or starch pills, may be examples of placebos [http://skepdic.com/placebo.html- Last accessed: 10-04-04].

were some functions that were introduced in the course, but were not being used in the everyday work practice. For instance, the health personnel were taught in the courses that they should navigate through the document (which is the pre-defined template), by using the "shift" button. However, most of the health personnel that I observed navigated in documents using the mouse. This implies that the brackets in the pre-defined template had to be moved manually, something that take longer time. Another example of the unfamiliarity with the system, is the long lists of rough drafts; user who started writing rough drafts in the wrong patient record, forgot (or did not know how) to shred the notes. Generally speaking, observed a phenomena show that there were some users which were unfamiliar with the system, i.e. users forgot to log out from DocuLive, or users who did not know how to sign an electronic note. In sum, after the implementation of DocuLive, nurses and physicians spent more time in front of the computer.

However, many of the initial bottlenecks that were faced in the NEV during the first phase, were technical. Problems with slow computers and unstable system were faced; DocuLive crashed often, and the synchronization process between PiMS and DocuLive was too slow (e.g. it took a long time before information that was registered in PiMS, was updated in DocuLive). Moreover, having unstable printers, as well as lack in the amount of printing devices caused to long printing queues. In some situations, printers that should have been connected to the network, were connected locally to one computer, and lacked the proper drivers. The problems with the printers caused situations were the printing queue was continuously increasing, and even contained old requests from a month ago. One of the team-leader nurses expressed her opinion in the following way:

> N: "*when things* [the technological devices] *do not work properly as they should, I get frustrated and lose tolerance"..."I do not understand why do I need to use so much time just in order to print out the new patients-lists before our* [the nurses'] *meeting"…*

Indeed, when looking at the long printing-queue for two printers, the staff from the support-team found up to six and seven requests for printing the same document. The health care providers do not know how to delete the printing-requests.

Another nurse told me about a situation that she faced during the start phase. She had a night shift and was supposed to teach two other nurses how to use DocuLive. Two emergency patients came to the department, and the system (DocuLive) crashed. She tried to phone the ITA, but there was no answer. She went to the neighbor department and realized that the system crashed in the whole hospital.

Nurse C describes her frustration:

> C: *"During the start phase, when I had a night shift, there were two emergency patients that came to the department. I was supposed to teach the two other nurses who were on duty, to use DocuLive, and my knowledge was very minimal"…"Suddenly, I could not log into DocuLive. I thought that it was me who did a mistake or forgot something. But I thought that it was weird because I was sure that I pressed on the right buttons and followed the tasks that I was supposed to"…"At this time, I tried to phone to a number* [to the HelpDesk team] *that we received from the IT department, but there was no one who answered the phone"…"I went to the department next by in order to see if there was someone that could help us, but then we were told that DocuLive was stopped* [shut down] *in the whole hospital. So we had to write the note on a paper* [instead of transcribing it into DocuLive]*"…*

After discussing the case with other personnel, I have been told that the system was down due to updating and maintenance of the server (this is a monthly routine where the system is being shut down for a period of time). Information about the dates of which the system is shut down can be found on the intranet, however at this period, there were very few nurses who knew how to retrieve information from the Riksnett (which is the local intranet in the hospital). Drawing upon the empirical material that was collected during the first phase, there were various comments reflecting on the frustrations that were derived from lack of sufficient support (through the telephone) both after the work-hours (meaning after 16:00 and 17:00 PM) and during the weekends.

Other initial complexities concerned the nurses who suffered from lack of available computers in the ward. In the neurology department, there are approximately thirty nurses who had to share five computers, where two of them are placed in the corridor and shared with the physicians. The fact that only one nurse can be logged on at a time, was very challenging.

In sum, when looking at the functionality of the electronic record, the nurses used the system mainly for writing notes. The same may apply for the physicians, who used the system mainly for validating and signing notes. However, when the physicians or nurses wanted to retrieve information about a patient, they often used one of the following information sources: the paper-based record, the workbooks[21], or the curve-books[22].

5. 1. 2 – The adaptation phase

When the development and implementation phase was completed, there was an increasing focus on organising a network for support and teaching.
The contact personnel (user-contacts) who were chosen earlier to represent each occupational group in the various departments, were gathered for monthly meetings with the staff from the IT department. The general aim of these meetings was to receive feedback from the users in order to follow the adaptation process of DocuLive in the various departments. In addition to the users-contacts, the IT department established a group of so-called super-users. This group, included personnel who were supposed to represent each occupational group from each department. These users were assigned additional responsibilities such as: to inform the IT department about new users, or about users who left or went out for permission (in order to stop the access to the information

[21] Workbooks (in Norwegian= arbeidsbøker): There are hard files (binders) that are created for each patient within the admission. The file is divided into ten chapters, and contains mainly the nurses' documentation and is kept in the ward. When the patient is discharged, all the nurses take out all the documents from the workbook, and send them to the secretaries who are responsible for storing the documents in the corresponding chapters, in the paper-based record.

[22] Curve-books (in Norwegian= kurvebøker): The nurses are always divided into teams; two teams are for regular patients, and one that is responsible for surveillance patients. Each team has one curve-book for all the patients that belong to this team. These books are called curve-books as they contain curve sheets (e.g. F1, F3.0). The curve-book accumulates information about the medicines, critical information, examinations that the patients are supposed to attend, and laboratory test results that are generated during the patient's stay in the department. These books are also referred to as "the doctors' workbook"- since the doctors uses the forms to order medications and examinations. However, the nurses use the curve-books to mediate and register the requests, and the ward-secretaries use the curve-books mainly for registering the patient's appointments for examinations.

and to transfer the work list[23] of the following person). The main responsibility of the super-users is to keep themselves updated through the user-contacts and Riksnett, in order to distribute the information internally in each department. In other words, super-users can be seen as the linking communication channel between the IT department and the health personnel in the various departments. Moreover, super-users should have a fairly advanced knowledge about the various features in DocuLive, and should be able to provide support for their occupational group. Among the others, super-users should be able to: forward work-lists, fill up and extend sick-leave notes, be familiar with the Help function and building prescriptions' templates, etc.

At this point, users were given the possibility to customize DocuLive (to some degree) so that it will accommodate their heterogeneous needs. They were given the possibility to build their own prescriptions' templates, as well as to adapt the pre-defined template for writing notes[24] in DocuLive. However, according to my empirical data, there were few users who were familiar with these additional possibilities of changing templates.

Gradually, modification had been done in DocuLive in order to accommodate the special needs that exist in the Neurosurgery department, as this has a different nature from other departments. Adaptations were done in the existing signing policy for epicrises. Currently, the existing policy for epicrises that are sent to other organisations is strict, and implies that an assistant doctor must have a contra-signature from a head doctor. The IT department customized the electronic record in such a way that both head doctors and assistant doctors would be able to sign each other's epicrise. This development of the ad-hoc solution was an exception that was conducted due to the fact that the neurosurgery department deals very often with emergency cases. They face situations where the patient for instance is about to be transferred to another hospital with a helicopter, and they are waiting for the epicrise to be signed and given to the patient. If the responsible head doctor is in another operation, other doctors must have the possibility to sign the epicrise. The time aspect is incredibly crucial, and accordingly does not allow having such constrains and restrictions as the ones posed by DocuLive.

After three month of using DocuLive, there were still various bottlenecks and complexities that were faced. Similar to the first phase, problems with various technical devices could still be observed, i.e. printers that does not work (at the NEV) and slow system when running PiMS and DocuLive simultaneously. Beside this, there were various concerns which were mainly expressed by the secretaries, about the structure and layout of the notes in the electronic record (e.g. the chronological order of the different fields in a formal letter). The current structure in DocuLive is very restricted, and there is no possibility to move fields or change the chronological order of the notes in the records. The empirical material from this phase, shows moderate user satisfaction when considering the ease of use of the system. The attitude of the users varied to a large extent, having enthusiastic and active users on the one side, and passive users who showed little interest on the other side.
Gradually, collaborative learning between the various personnel could be observed. In one of the wards, I found a little notebook that was hanging on the book-shelves (see

[23] The work list is generated from DocuLive, and gives an overview of the notes that were transcribed, but have not been validated and signed yet.
[24] The pre-defined template for writing nursing notes in DocuLive is based on the VIPS (Velbefinnende Integritet Profylakse og Sikkerhet) standard.

figure 5.1.1), and contains notes that the nurses wrote about DocuLive (e. g. how to extend the search function) Nurses, whom are used to work in teams (as they are usually divided into teams), sit together in front of the computer and help each other to write notes in DocuLive. The same phenomenon was observed with the secretaries, who are also used to cooperation in their everyday work routines. Several users told me that they prefer to help each other, rather than to use the help function in DocuLive. The user-contacts and the super-users were supposed to provide additional support to the healthcare personnel. However, based on my empirical data from two departments, there were many health personnel that did not know who their contact personnel or super-users were.

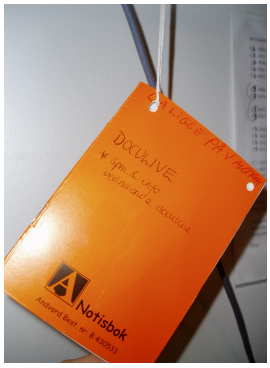

Figure 5.1.1: Notebook

The work practice for transcribing, correcting and validating notes varied between the different departments. In some departments, there were no changes in the work practice. The secretaries were still responsible for transcribing notes, printing them out and handing them over to the physicians so that they would correct them. This was done by marking the correction on the paper-based notes, and handing them over to the secretaries. When the secretaries completed correcting the electronic notes, the physicians would validate and sign the notes. In other departments, the physicians realized that instead of sending notes back and forth to the secretaries, they could correct the notes by themselves. Thereby, the physicians situated work practice for notes was extended to include the additional task of correcting transcribed notes. There were some physicians who rejected the idea of having this additional task, by claiming that the secretaries will not learn from their mistakes if the physicians will correct their transcribed notes themselves.

One of the prevalent bottlenecks during the second phase was the problem with the physicians' signing routines, and this was identified in several departments. After the transformation to electronic patient record, the lists of the unsigned notes were rapidly increasing. This was a consequence of the situation where physicians used long time to sign the electronic notes. This is due to various reasons, where one of them might be that the physicians could not sign the note before they have received reply for the examinations. When a note is being written in DocuLive, it is has a watermark in the background indicating that the note is a "rough draft", and the note is not visible as long as it is in this status. As soon as the author validates the note, the watermark is removed and it becomes obtainable for others. The fact that the note is not visible until it is validated and signed by the physicians, was, in some situations a bottleneck in the information flow. For instance, consider the following observed situation were a patient was transferred to a rehabilitation centre. Due to the fact that the epicrise was unsigned, it could neither be sent with the patient, nor stored in the paper-based record. This had two consequences, where the first one is that the rehabilitation centre did not have any information about the patient. Secondly, an unsigned epicrise cannot be printed out and stored in the paper-based record, as it is being marked with an "unsigned" watermark in the background and treated as an incomplete note. As a result, the paper-based record was inconsistent and lacked information. Subsequently, when the epicrise was signed, it was printed out and sent separately to the archive department to be put in the corresponding record. A secretary told me the following, when I asked her about their printing-routines:

F: "*I usually print out the epicrise that I transcribe, in addition to the admission-note. But before doing that, I always check that all the pages exists in the paper record...There might be situations, for example, were other departments who previously had the patient could not print out the epicrise because it was not signed by the doctor*"...

An interesting issue was that the prevalent problem of signing routines did not exist in one of the departments in which I conducted my fieldwork. When I asked one of the secretaries whether she was familiar with the problem, I received the following answer:

A: *"Our doctors have very good singing-routines"..." They correct the transcribed notes by themselves"..."If there is something unclear, then they* [the doctors] *can look at the paper-record and see what is missing. But we do not correct notes anymore"..."We received a clear message from the office director that it is the doctors whom are responsible for that* [correcting notes]*"...*

During this phase, limited pure use of the available resources can be identified. This implies that additional functions such as: electronic sick leave forms, prescriptions, and help functions are being used to a very little extent. In order to encourage physicians to use electronic prescriptions, the super-user secretaries were thought how to build templates for the physicians. However, when I asked one of the secretaries if she knows whether the physicians used electronic sick leave forms and prescriptions, she said the following:

A: *"So far, I do not think that there are so many doctors who uses these functions, though, I have seen one doctor who did* [used electronic prescriptions and sick leave forms]. *I think that most of them prefer to write it by hand"..."When we were in the super-user course, we were told how easy it was to extend prescriptions and sick leave forms. And we were even asked to encourage the doctors to use these functions"…"But, eventually, it is the doctors who decides what they prefer to use, and I have to respect it. Some of them have been working for 20 years, and I can understand that they prefer to use the pen and paper".*

When I asked several secretaries and nurses what was the reason for not using the additional Help function in DocuLive, they told me that it was easier and faster to just ask the person next by. Another nurse told me that they are short in time, and that things must happen fast, as her example shows:

C:"*We are often short in time, and things happen very fast. Let's say, for example, that a patient must suddenly be transferred or picked up by an ambulance. The rapport then, must be completed and sent with the patient. Therefore, if I have troubles with printing the rapport, it is easier and faster for me to ask someone else to help me, rather than to use the Help function*"...

After the transformation to electronic record, all the users were requested to keep both the paper-based and the electronic-based record updated. Consequently, secretaries and nurses printed out each note that was written in DocuLive, and stored it in the paper record. If a clinical note was changed or updated, it was printed again and added to the paper record. Moreover, each time a laboratory tests result was generated (in EROS), the results sheet was printed and added to the paper record. Since not all the test results can be produced and generated at once, the results sheets that were printed out were incomplete. Accordingly, the paper record contained several incomplete test result sheets, as well as the last sheet which included the complete test session. Obviously, the

redundant laboratory sheets and the clinical notes should have been discarded when new and recent information is stored. However, it has been a common practice among the health personnel to leave the responsibility of shredding redundant notes and straitening up the records to the secretaries. This was not always practiced, and the volume of the existing records gradually increased. In sum, the transformation to electronic record which had a general aim of reducing the production and circulation of paper, ironically caused to the opposite situation where a higher amount of papers was produced. As a result, the archive department was suffering from increasing shortage in physical space.

Trying to address the crises in the amount of papers that are being produced, the IT department introduced new printing practices that would help to avoid unnecessary production of papers. According to these new routines, all the clinical notes should be printed out when the patient is discharged. This implies that there is no need to print out each epicrise and note that is written in DocuLive. In addition, the IT department suggested that if a patient had been admitted to several departments, the last department should have the responsibility to print out all the notes that had been produced in the various departments, during the entire stay in the hospital. However, the implementation of the new printout practice proved to be difficult. When the routines were introduced during the super-user courses, there were few users who rejected the new routines while claiming that they cannot change their work practice. At this point, signs of re-emergent of local sections with the common record became visible. Trying to investigate the following situation, I asked one of the healthcare providers if he could explain to me why it was difficult to change the existing printout practices. His comment was the following:

> M: "*As long as we do not have one common record, and we do not, so we face the problem that we need to print out everything that is being written for each patient in each record, also the documentation that belongs to the other departments. Otherwise, we do not get continuous documentation (notes) [...] DocuLive presupposes/assumes that we have one common record. When we do not have it and we have instead maybe four different records for one patient, so all the documents from all the departments must be printed out four times, and stored in each record".*

Another personnel told me the following:

> N: "*Actually, the* [patient] *records should have been merged into one common record. But we have our own* [records' sections] *because our patients are often control patients that comes each third month, and they get very huge records"..."When we moved to Gaustad, all the departments' local records were merged into one record. This means that our records looked like a nightmare when we wanted to admit a patient. It was not particularly gratifying"…*

In sum, due to the lack of capacity, the archive department was never able to fully complete the project of merging the paper-records. There was a shortage in personnel who could straighten up the paper-based records in a proper way, and thereby the volume of the record increased and became less user-friendly. Due to this, and the situation mentioned previously (where several redundant notes and laboratory sheets were stored in the paper record), it was difficult to find relevant information, and initiatives for re-emergence of local section within the common record arose. This implies that all the information that is produced in one department is being stored in a separate "soft binders" (folder). Thereby, parts of the clinical information existed in the electronic-based record, information that had been produced before the implementation of the EPR existed only in

the paper-based record, and redundant information existed in the local sections within the paper record. In other words, the patient record was fragmented, and several incomplete and hybrid information sources existed.

Drawing upon the above description, most of the health care personnel used DocuLive in their everyday work practice. However, it has been difficult to achieve consistent use of the system across occupational groups in various departments.

5. 1. 3 – The last phase: impact and effect of the EPR

During this phase that stretched over a period of six months, there was an increase in the number of the users who pointed out the advantages of the transformation to DocuLive. Drawing upon the empirical data, I could find repeated comments about the advantage of having continuous and rapid access to patient records (obtainability), and having the information in a digital form (which implies solving the problem of nurses who struggle to understand hand-writings of physicians). Gradually, some of the head nurses and office directors took a more active part in encouraging their personnel to use the available IT resources in their everyday work practices. For instance, one of the head nurses decided to use the mail as a communication channel with the nurses, instead of hanging message and announcements on the blackboard that is located in the ward. Accordingly, she created a common mail-address which includes her group of personnel, and used it to send interdepartmental information for the nurses in this unit. This was done consciously, to encourage the nurses to use the available IT resources (i.e. the intranet and mail programs).

Similar to the other phases, there were various complexities and problems that were faced by the users. The empirical data from this phase, outline the need for better supporting layers. One of the nurses told me about the various situations where he called the support team from the IT department:

> R: *"I already called the IT department* [the HelpDesk team] *several times, and told them about this problematic printer that we have here in the ward. But, each time they ask me if I have another printer that I can use instead"..."Other times when I call them, I receive a 'case-number'* [since this is being registered]. *But I do not have a need for a 'case-number', I have a need for a printer that work properly"...*

Over a period of time, the existing work practice had been gradually changed, and various routines and procedures had been developed around DocuLive. The system started to be used not only for validating and signing notes, but also for retrieving patient data. All of the physicians in both departments (the NEV and NKI) corrected the transcribed notes by themselves. Moreover, there were gradually more physicians who were interested in learning how to transcribe electronic notes in DocuLive.

However, the use of DocuLive was still sub-optimal, as there were several available features in DocuLive that were in use only to a limited extent. I asked one of the physicians whether he uses electronic sick leave forms or prescriptions, and he said the following:

> Dr. O: *"I have tried it, but I found it to be very laborious and inconvenient, specially the electronic prescriptions. It demands too much time"…"Beside this,*

we often write these when we sit with the patient, because we need information like the employer's name etc."…"And not always do we have a computer next to us"…"Usually, we just find a treatment room that is available"...
Nina: *"But what about the long-term prize of reusing information from prescriptions and sick leave forms?"*
Dr. O: "*You see, it is not us who keep the continually renewing of the prescriptions"…"It is either the primary doctor, or that they* (the patients) *come back to us once each six month or year. Therefore it is easier for me to just write it by hand".*

Other physicians who also tried to use these features claimed that it demands time and effort to click up all the boxes of these features.

The distinguishing feature of this phase is that discussion concerning other systems than DocuLive arose. During the first two phases, most of the discussions concerned the need to accumulate (integrate) new chapters and forms in DocuLive. However, during this phase, comments concerning the lack of integration arose. Various users expressed the need for integrating DocuLive with the different systems that are being used (e.g. EROS, Albert). When I asked one of the head doctors what was his opinion about DocuLive, now after using it for approximately a year, he said the following:

Dr. F: *"As the situation is today, DocuLive is a pure typewriting machine"… "There are many additional functions that the electronic patient records lacks, like for example: the ability to request laboratory test results, integration with PACS and RIS etc."*

Another doctor (from a different department were they used DocuLive for approximately 7 month) told me the following:

Dr. E: *"Our greatest and constant need is to merge all the systems with DocuLive, so that we can avoid clicking on several documents, and 'jumping' through several programs"…"We should rather had one page which we could navigate through. This way, we could save much time"…"In fact, it could have been interesting to measure how much time it takes to log into all the programs"…*

We decided to measure the time that a physician uses in order to log into three programs that are often used to retrieve information before writing a note. The programs were: DocuLive, EROS, and an internal database that contains examinations results from the neurophysiologic laboratory (i.e. ECG's). Dr. E used four minutes and thirty-two seconds to log into these three programs (the ones that are mostly used) and to search for the patient.

Dr. E: *"If I needed any laboratory results from yesterday, I would have used five more minutes to find the information, and two minutes for RIS and PACS. So, in order to show you how much time goes on such tasks, I would have probably used ten minutes for each patient. Now lets say that I have thirty patients (like today), then I would have used five hours to look through the examinations results from yesterday".*

Summing up the above mentioned, there were no radical changes between the second phase and the last one. At the current stage the paper-based records are being used alongside the electronic patient record. This implies having work practices to maintain both information systems parallel. Consequently, the patient record is fragmented and hybrid.

5. 2 – Parkinsons case

I conducted a case study of a Parkinsons patient's trajectory, and generated a brief description that shows elements of a socio-technical infrastructure that cross disciplines, information systems, and work practices (following Strauss et al., 1985). This case was selected because it is a complex and lengthy process, that depends on interdisciplinary actors from several clinical and service departments who conduct various work practices that are essential for the overall workflow. Another reason for choosing this case was that I was interested in studying the interdepartmental relationship between the Neurology and Neurosurgery department, and this case involves mainly these two departments. I chose to describe an optimal complex case of a Parkinsons patient, who will be called Mr. Smith. The case is based on a real situation, but many details had been changed/altered in order to reserve confidentiality. In addition, pseudonyms are being used and real names of the staff and patient are kept confidential. In this case, I study the information and identify the multi-professional teamwork and collaboration around clinical work processes, including mapping pre-operative and post-operative procedures and patient case processes.

My description of this case contains both a detailed narrative description and graphical representation that map the complex activities/trajectories, the heterogeneous actors, and information flow. Here I illustrate how trajectories must be performed in a specific order, and how the medical practice cannot be rationalized due to its unpredictability. It is difficult for instance to predict a patient's reaction to a treatment, and the patient might not tolerate the medicine or the operation. Other unpredictable contingences can be identified, such as long waiting lists for diagnostic examinations that might delay a treatment, emergency cases or complexities with technical devices might suddenly appear and cause to postponing operation, and so forth.
I choose to facilitate and simplify the whole case by describing it as an optimal one, excluding some of the unexpected contingencies and complications that arise in such a complex case and causes to trajectories to go awry. Some optional sub-cases (unexpected contingences) were included in order to give a flavor of how the medical practice is highly complex, dynamic, distributed, and regulated. The description includes some specific details of administrative, operational articulation work and the coordination that is necessary for such a complex case. Among others, the case illustrates such phenomena as: multiple trajectories, initial steps in diagnosing, and the complexity of division of labor. I intentionally chose to zoom in only on some parts of the processes/activities and to provide a detailed description, in order to obtain a better understanding of the various work practices, artifacts that are being used, and the various communication channels etc. Other parts of the workflow are kept in a macro perspective by zooming providing a general description.

The material of the cases is based on eleven interviews, seven observations, and one shadowing session. I tried to use respondent validation from some of the personnel in order to gain a better credibility towards the case. However, I was forced to base some parts of the sub-cases on general assumptions. For instance, the description of the patient's admission is true for a general case of a hospital admission. This implies that several parts that are described here are true for a general case, but I had to relate them to Parkinsons case.

General information about Parkinsons Disease (PD) and its symptoms

People who suffer from Parkinsons Disease (PD) experience increasing motor behavior impairment, and it usually occurs at an older age. Parkinsons Disease (PD) includes the following primary symptoms: muscular rigidity, difficulty with movement initiation and slowness of voluntary movement, and difficulty with balance and walking. Usually these symptoms start in one side of the body, and gradually disperse to the other side.

The cause of the disease is believed to be a dopamine deficiency in the basal ganglia of the brain. Dopamine is a neurotransmitter, a chemical messenger in the nervous system (between nerve cells in the mammalian brain). In PD the neural cells which produce dopamine deteriorates and gradually disappears, and this cause to the decrease in the normal rate of dopamine production. It was discovered that it is at this stage that Parkinsons symptoms start to appear. In addition to the PD's primary symptoms, the patient may start to suffer from secondary symptoms such as senility and difficulty in speaking.

The earliest symptoms of the PD may be non-specific and the patient might suffer from only one or two of the symptoms. Therefore it might be difficult to diagnose the disease for some time. Very often, the doctors can clearly identify Parkinsons Disease only after a period of at least 5-7 years. There are several methods for evaluating the possible presence of the PD. The first diagnosis is based on the evaluation of the presence of the primary symptoms. In order to diagnose further the presence of PD, a trial test is being conducted. This is called: United Parkinsons Disease Rating Scale (UPDRS), and it tests how many points the patient scores with and without (or before and after) Levodopa (L-DOPA) which is his morning medicine. Without this medicine, the patient reaches a condition of an absence of dopamine in the brain. Levodopa is a precursor in the biosynthesis of dopamine in nerve cells (can be transformed to dopamine,) and causes to the increase in the production of dopamine. Therefore, when the patient does not receive Levodopa, he reaches the worst state in this disease where his muscles are extremely stiff. This is the state that patient will reach in ten years, if he will not be operated. Hence, when conducting the UPDRS examination, the head doctor can see for how long time the medicine affects the patient, and will be used as a background for evaluating the best treatment for the patient, and clarifying the benefits and disadvantages of continuing with medicines, versus conducting an operation.

Scans of the brain such as, Computed Tomography (CT) or Magnetic Resonance (MR), may be helpful in sorting out other diseases that have similar symptoms to PD. These may include neurological disorders that lead to Parkinsonian symptoms, yet these symptoms should not be confused with the PD[25].

Stimulator implants for Parkinsons patients at Rikshospitalet

Rikshospitalet (RH) began conducting the stimulator-implants for Parkinsons patients in 1995. This brain-stimulator is supposed to help Parkinsons patients stop shivering. Before Rikshospitalet had the practice of implanting brain-stimulator, they used to destroy a small centre in the brain. Roughly speaking, this was done by drilling a hole and inserting an injection that destroyed this small centre in the brain. Since this surgery demanded complete precision, the patients had special frames on their head both when they went for X-rays and during the surgery.

[25] *The Dopamine Theory of Parkinson Disease*: http://tcw2.ppsw.rug.nl/~vdbosch/pd.html, 17.09.2003

A surgery as in Parkinsons operation implies a high psychological tension. This is because of two main reasons. The first one is that most of the patients usually wait a long period due to the high overload in the number of the operations. Another reason is that, as in every other operation, there is a risk that must be taken into consideration. This risk implies either that the surgery might not help, or that the patient's condition might become worse after the surgery. Most patients get much better, but some have no or little effect from the operation. While for some patients the effect may be immediate, it may be delayed for others. Hence, these patients demand extensive control and follow-up also after the surgery.

After transplanting a brain-stimulator which helps them stop shivering, these patients must come for a "day-control". This in order to configure the stimulator and the medicines, and in order to have a general control and ensure that the stimulator is working properly. The patients have to come for control and follow-up after three month, six, nine and twelve month. After one year from the surgery, they come once in a year, only for one day-treatment[26].

Rikshospitalet had several functions in the national basis, in transplanting brain-stimulator for Parkinsons patients. This has altered due to various political changes within the health sector. At the current state, any hospital that has the competence to perform such operation can do it. However, it is worth to mention that this type of operation is being conducted only in few hospitals in Norway, such as Haukeland hospital in Bergen, and the hospital in Stavanger. Thus, most of the Parkinsons operations are being performed at Rikshospitalet. Each year, approximately 100 Parkinsons patients are being admitted to the Neurosurgery department (NKI), and there are about 600 outpatient consultations. Approximately 70 Parkinsons operations had been conducted last year (year 2002).

"Utenlands-milliarden"

Rikshospitalet (RH) had been facing constrains in conducting Parkinsons operations due to the long waiting lists. Thus, for about three and a half years ago, Stortinget (the Norwegian Parlament) decided to give Rikshospitalet one-milliard kroner in order to conduct Parkinsons operations abroad.

Rikshospitalet chose to cooperate with the hospital in Kiel (Germany), and to send Parkinsons patients to perform the operations there. Such operations are being paid by Rikstrygdeverket, and are not sponsored from Rikshospitalet 's budget. The health personnel from Kiel decided to send neurological surgeons to the Neurology department (NEV) at RH, in order to check if they agree with the decision of the neurologists and the surgeons (from the Neurosurgery department) about conducting an operation. In addition, the neurologist surgeons talk with the patients in advance in order to decrease the stress and pressure that is implied in traveling abroad. The health personnel from Kiel come to Rikshospitalet about approximately 2-3 times each year to see the patients.

Rikshospitalet used to have cooperation with Århus (Denmark), but due to the limited budget they cannot operate as many patients as before and therefore they do not need more than one center. The hospital in Kiel has a potential to operate approximately 25-35 patients in a year, thus by adding to this the number of patients that Rikshospitalet can operate, Rikshospitalet can cover/ reimburse its needs.

[26] Patient's whom are given a day-treatment, leaves the department after 5 hours.

The Neurology department (NEV) performs diagnostic tests (examinations) before the operation, and transfers the patients to Kiel in order to have the operation. When the operation is completed, the epicrises are sent to the Neurology department (NEV) and the patients come back to Rikshospitalet for follow-up and control.

In summer 2003, a decision was taken to stop financing brain-stimulator operations that were conducted abroad. This implies that Rikshospitalet does not have the possibility to send patients for operations to the hospital in Kiel.

Twelve possible steps

The following steps are provided here as sub-units of analysis of the work practices in the management of a Parkinsons patient case.

A. The Neurology department receives a referral letter
B. Admission to the Neurology department
C. Diagnostic tests of the patient at the Neurology department
D. Discharge of a patient from the Neurology department
E. The Neurology department sends request for an operation to the Neurosurgery
F. Parkinsons meeting (Neurosurgery, Neurology)
G. Operation meeting in the Neurosurgery department
H. Admission to the Neurosurgery before operation
I. Operation
J. Transferring patient to the Neurology department for recovery and control
K. Discharge patient from the Neurology department
L. Control after operation (Neurology)

Diagrams

The numbers that are used is this description follows the numbers in the graphical figures/diagrams that can be found below.

One can apply various model languages or notations such as the Unified Modeling Language (UML) which is a standard diagramming notation, and provides among others, use case diagram notation [27], and System Sequence Diagrams (SSD)[28] (Larman, 2002). I decided to develop for this purpose an ad-hoc method that is based to some degree on the previous mentioned notation. My aim was to implement some kind of notation that will make the central actors, the processes and the activities visible. In addition, I attempt to describe the information flow and interaction between the various actors (the use of various communication channels)

I choose to draw one graphical diagram on the general level, using the macro perspective (see the diagram entitled "Parkinsons Patient: Level 1", figure 5.2.1), in order to zoom in on two of the (interrelated) activities, and divide them again to two sub-diagrams using a micro perspective in some of the processes. The first sub-diagram, entitled "Parkinsons Patient: Level 2 [9-11]" (figure 5.2.2), maps the activities that are performed at the Neurology department, while the other sub-diagram, entitled "Parkinsons Patient: Level 3 [11-12]" (figure 5.2.3), maps mainly activities from the Neurosurgery department. The first graphical diagram shows three critical phases and

[27] Use case diagram notation illustrates the names of use cases and actors, and the relationships between them.

[28] System Sequence Diagrams (SSD) are used for a particular course of events within a use case, and illustrate the events from external actors to a system.

levels of decision-making. The first level of decision-making is indicated in process number six, and it is based on the epicrise that is sent from the hospital who transferred the patient to Rikshospitalet. Process number nine indicates the second level of decision-making, which is based on intensive pre-operative tests. Finally, the last critical level of decision-making is process number twelve, were all the diagnostic examinations had been conducted, and the neurologists meets the surgeons in order to make the final decision.

I would like to indicate the abbreviations that I used in the graphical diagrams:

NEV = The Neurology department	NKI = The Neurosurgery department	pat. coord. = Patient coordinator	secrt. = Secretary
pat. = Patient	doc. = Doctor	ass. = Assistant	contrl. = Control

I would like to indicate the meaning of the symbols that are used in the graphical diagrams:

LEGEND:

Ativity/ Event	Information flow	Actor- patient	Forms
DocuLiveEPR (DL)	Requisitions	Several documents	Paper-based files
Database	Cassette	Internal Post	Telephone
Pipe-post	Ref. letters to the physiotherapy dep.	Critical phases	Comment/ Note

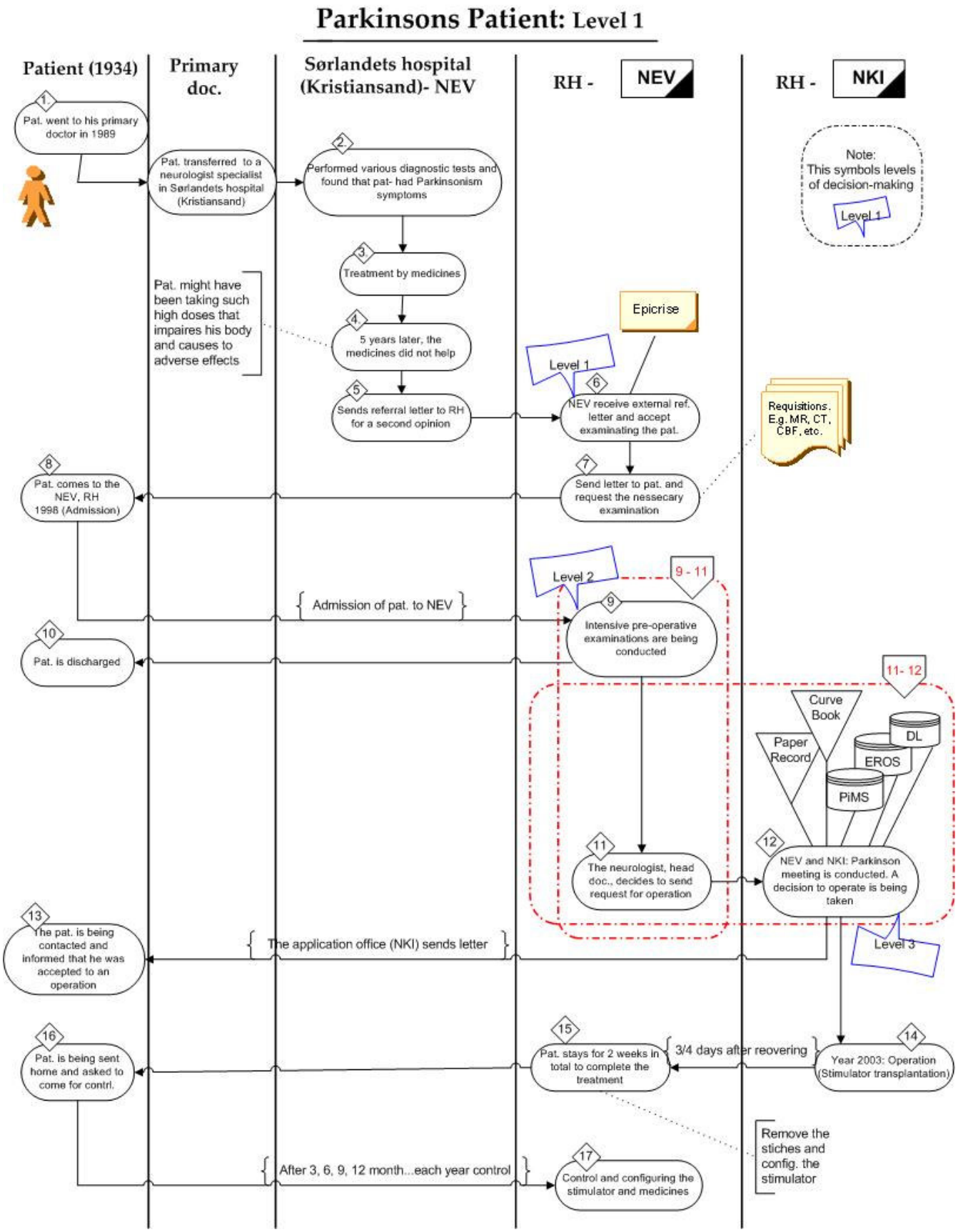

Figure 5.2.1: Parkinsons patient: Level 1

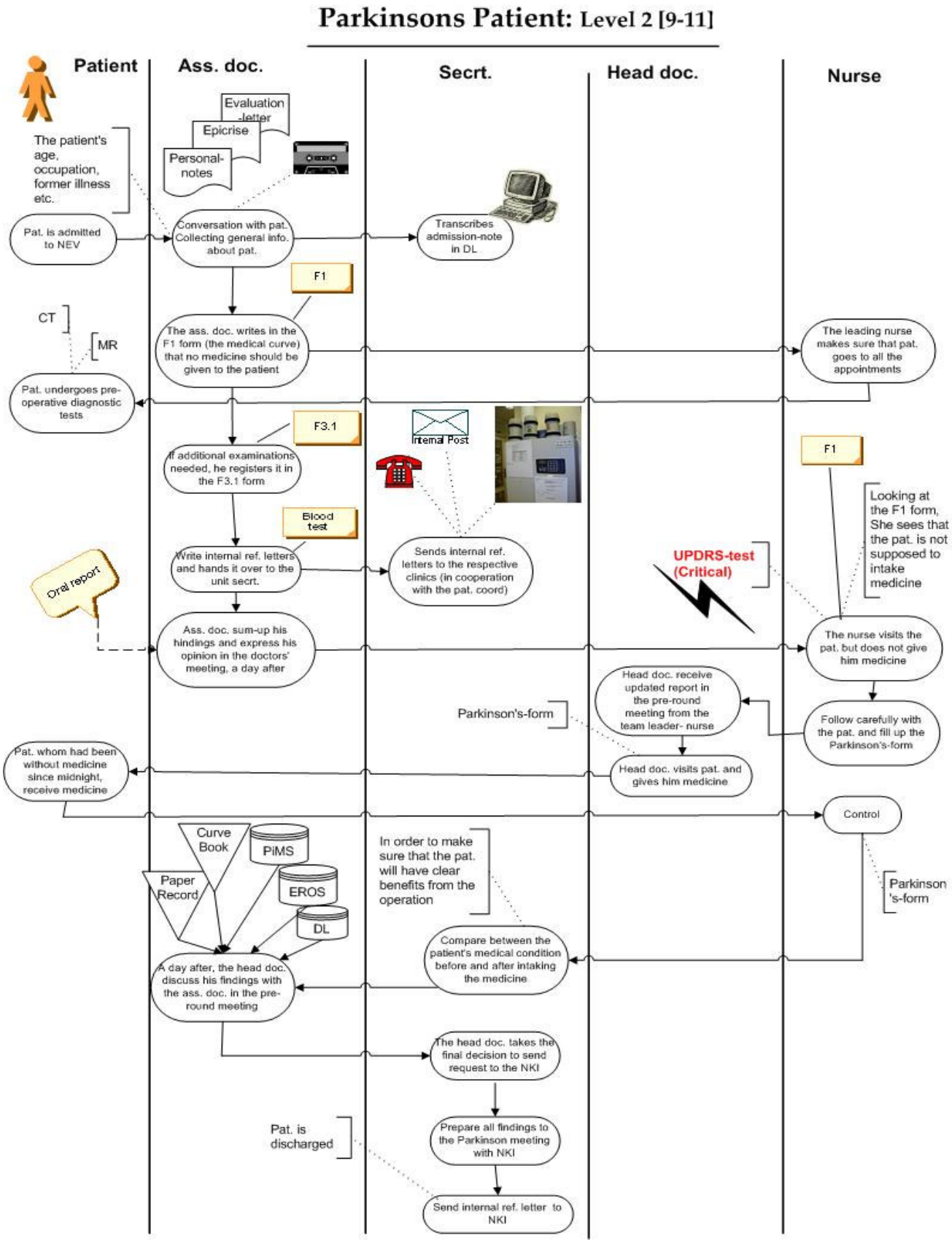

Figure 5.2.2: Parkinsons patient: Level 2 [9-11]

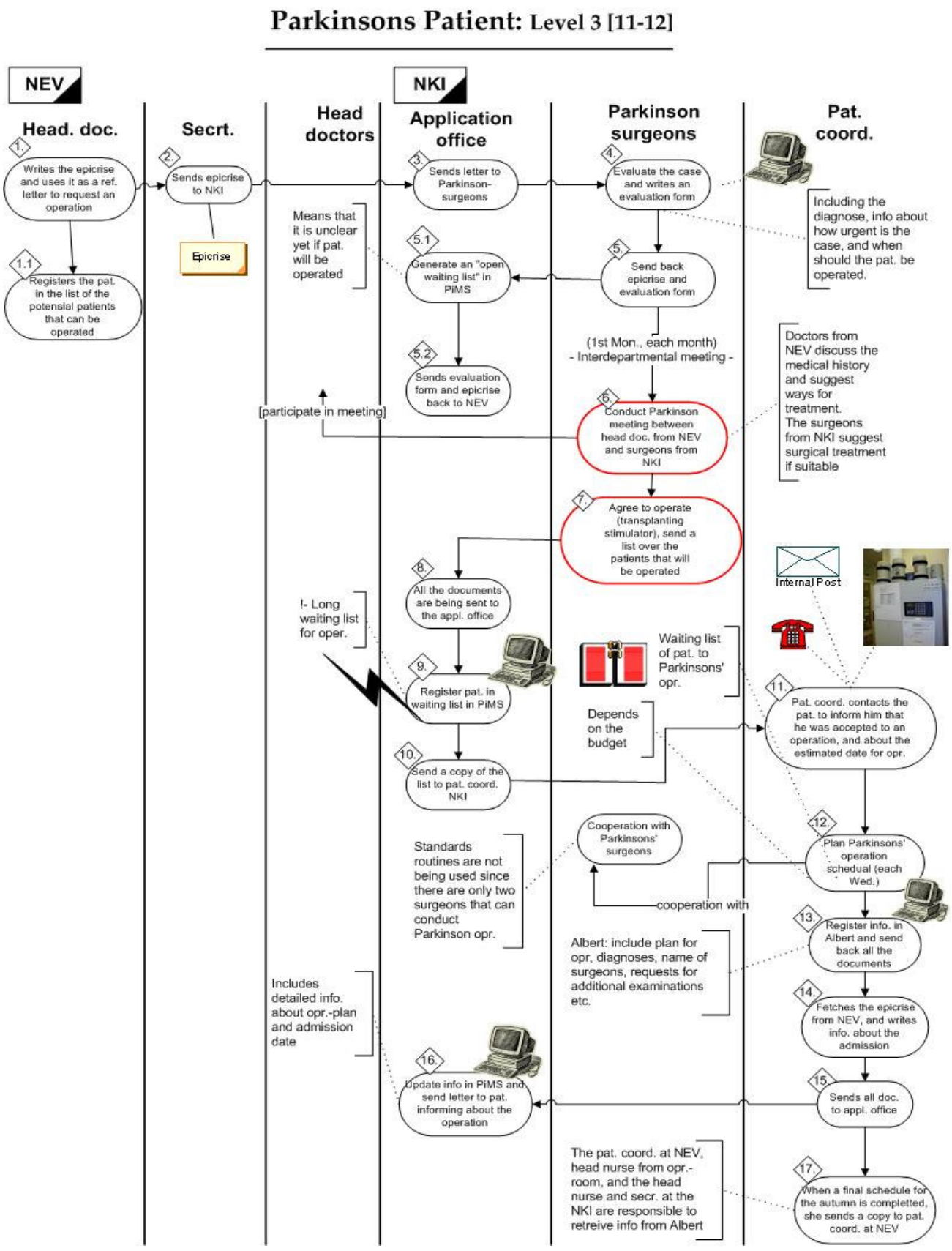

Figure 5.2.3: Parkinsons patient: Level 3 [11-12]

Mr. Smith - 68 years old patient (1934)

1. Mr. Smith was born in 1934, and is 70 years old now. In 1989, Mr. Smith started feeling unwell and therefore decided to visit his doctor in Mandal [which is part of West-Agder county].
2. Mr. Smith's primary doctor noticed that his patient started suffering from symptoms that resemble Parkinsonism, and therefore sent him to a specialist at the Neurology department (NEV) at Sørlandet hospital HF in Kristiansand.
3. There he was treated with medicines that were supposed to prevent, or at least decrease, those symptoms. Just as every other medicine, there is a limit for the amount that a patient's body can intake. This limit varies depending on the medical history and the existing medical condition.
4. As the time went by, Mr. Smith needed higher doses of medicine. After 5 years, Mr. Smith had been taking such high doses of medicine that it did not help him anymore. His body was weakened and impaired, and he experienced/suffered adverse effects as a result of taking such high dose of medicines.
5. Therefore, the neurologists at Sørlandet hospital in Kristiansand, decided to send a referral letter to RH asking for a second opinion and requesting proposal to other prospective treatments.

A. The Neurology department receives an external referral letter

6. The NEV department receives the referral letter and decides to examine Mr. Smith:
    a. The patient coordinator receives the external referral letter via the post or the doctor. She attaches to the letter an empty evaluation-form (paper format which does not exist in DL) and places these forms on the shelf labeled with "*Referral Letters for Evaluation*", or more precisely, on the shelf that belongs to the specialist who deals with Parkinsons cases.
    b. Each period there is one head doctor that is responsible for the referral letters and applications. A glance into the shelf, give the head doctor a quick overview of the current state of work (the workload). The responsible head doctor fetches the referral letter from the shelf. After reading it, he fills up an evaluations form, there he includes information about how urgent the treatment is (when should the patient be admitted), and prepares a complete plan describing the supplementary examinations that must be pre-ordered. The clinical examinations are pre-ordered in advance in order to prevent from wasting time when the patient is admitted to the department. The clinical examinations that are usually ordered in a Parkinsons case are: Magnetic Resonance (MR), CT, testing physical movements, United Parkinsons Disease Rating Scale (UPDRS) and the CBF examination (Cerebral Blood Flow[29]) which is used in order to rule out other diseases whose symptoms resemble PD.

[29] The CBF examination evaluates if the amount of blood that flows to the brain is sufficient. If there is a lack in the amount of blood flowing to the brain, then it means that there are some dead cells in the brain.

c. If the patient had previously been admitted to other departments at RH, the head doctor writes the names of those departments. When the evaluation is completed, the head doctor places the forms on the shelf labeled with "*Evaluated Forms.* The visibility of the forms in the shelves is important in the division of labour and job rotation at the dep. This way, the medical staff uses the written documents to support coordination of work
d. Then the patient coordinator registers the patient in the waiting list in PiMS, and moves the forms to the "*Ward*" shelf. This implies that the forms will be transferred to the ward.
e. The head nurse keeps the referral letters in her office until she meets the patient coordinator and together put up a date and time for the admission.

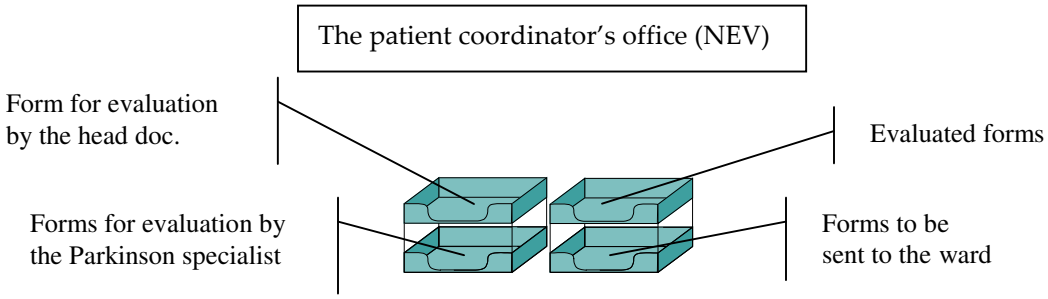

Figure 5.2.4- Information Flow System for Referral Letters

f. Then the patient coordinator is responsible for pre-requesting the so-called "heavy examinations", meaning the ones that have long waiting lists and difficult to get appointment to (e.g. Magnetic Resonance (MR), types of Scintigraphy, Rheumatology). In other words, she sends the referral letters to the various clinics before the admission of the patient. The post secretaries are mainly responsible for the examinations that are being ordered while the patient is admitted. But they cooperate with the patient coordinator and order the examinations that she does not get to order in advance.

Ordering examinations is done in various ways using different communication channels depending on the work practice in the divers clinics. Blood test examinations and EEG's are ordered by the pipe-post that goes directly from the department to the clinic in the first floor, and results may be retrieved electronically via the system Eros (see figure 5.2.1). Other examination such as MR, Reumatologic examinations, scintigraphy[30] etc., are order by the telephone, or by the internal post. More precisely, this is done by placing the requisitions on the shelf that is labeled with "Out post". Then the transporter, would pick up the internal post 3 times

Figure 5.2.5- Pipe post

In this case, the patient does not suffer from Parkinson's Disease and the Levodopa medicine will not help him. Therefore, implanting a brain-stimulator will not help the patient.

[30] Bone scintigraphy is a sensitive and efficient method of measuring metabolic activity of the entire skeleton [http://www.med.harvard.edu/JPNM/TF94_95/Jan17/WriteUpJan17.html, 21.10.03].

each day. The various clinics phone the patient coordinator and inform her about the appointments for the examinations.

g. Thereafter, the patient coordinator registers all the information about the patient in PiMS[31], including the appointments to the outpatient clinics and information about how urgent is the admission of the patient.

h. Then the patient coordinator places the forms on the "ward" shelf, so that the secretaries will store all the forms in the ward. The referral letters will be stored in a special binders/file at the secretaries' office in the ward, and the evaluation forms will be stored in the ward (together with the patient records- if exist). If it is a long period until the patient will be admitted, the referral letter will be kept at the head nurse's office in the ward, and the paper record (if exists) will be sent back to the central archive. When the patient is admitted, the central archive will send the patient record automatically using the "pick-up" list in PiMS.

7. A letter is being sent to the patient inviting him to the NEV department at RH for conducting diagnostic tests[32] including pre-operative (pre-scheduled) examinations and evaluations. Since the following operation is carried with some risk, a complete examination must be conducted before reaching any decision about an operation. These examinations will help the surgeons to illuminate and sustain the final decision.

B. Admission to the Neurology department

Before the arrival of Mr. Smith to Rikshospitalet, Sørlandet hospital HF (Kristiansand) sends his epicrise to the Neurology department.

8. In May 1998, Mr. Smith is being admitted to the NEV department.
   If it was a case of a patient that was previously admitted at Rikshospitalet, then the central archive would have automatically sent the patient's paper record to the secretaries, using the "pick-up list" in PiMS. Then the paper record would have been kept at the secretaries' office during the admission period. But since in our case Mr. Smith is a new patient at Rikshospitalet, a new paper record must be created. When Mr. Smith is admitted to the NEV, a new manila cover is created, and a barcode-encoded ID sticker (containing the patient's personal number) is attached to the cover. This cover includes an A to J index (as in every other paper record), and it includes only documents that have been sent to the NEV, or written by the health personnel at the NEV.

   At 8:00 AM, the head nurse and the doctors, are gathered for their morning meeting, where they receive an updated report about the patients that were admitted the day before. In addition, they discuss the new patients that will be admitted to the department, and divide them in such a way that each patient will have a responsible doctors (the patients are divided among the doctors that are on duty).

[31] PiMS: Patient Information Management System, which is the Patient Administrative System. Contains demographic and diagnostic data for each patient for management purposes, i.e. non-clinical use.

[32] Diagnostic examinations refer to the intensive pre-operative examinations and evaluations. These are being conducted in order to rule out other diseases whose symptoms resemble Parkinson Disease, and in order to see if the patient would gain benefits from an operation. The elucidation includes among others, Cerebral Blood Flow (CBF), and United Disease Rating Scale (UPDRS) examinations.

C. Diagnostic tests of the patient at the Neurology department

Mr. Smith, who arrived today to the NEV department, will start with the pre-operative intensive examinations following special regimes at Rikshospitalet. These examinations will help the neurologists to sustain the final decision, and illuminate the benefits that the patient will have from the operation. During the first day, Mr. Smith will be seen by an assistant doctor, and if there is no need for additional complimentary examinations, he will be seen by one of the head doctors (that deals with Parkinsons Disease) on the second day. The head doctor will start treating Mr. Smith with medicine, in order to see how this affects his body. The average time period of the pre-operative diagnostic tests at the NEV department is approximately three or four days, assuming that it is an optimal case without complications, and that the diagnosis was correct. In 20% of the cases after conducting the diagnostic tests (examinations), it turns out that the patients suffered from other diseases whose symptoms resembled Parkinsons Disease.

9. The 1st day: At approximately 11:00-11:30 AM, after the morning meeting and the pre-round meeting with the staff, the physicians start their clinical ward rounds and visit their patients. Thereafter (at around 13:00-14:00 PM), they meet the new patients that they were chosen to be in charge of the new patients for whom they were assigned primary responsibility.

   An assistant doctor meets Mr. Smith in order to discuss his medical condition, and to inform him about the examinations that he will have to go through. Besides this, the assistant doctor collects general information about the patient, for instance his age, his occupation, how is he living, information about his relatives, and his medical history.

   After this conversation, the assistant doctor dictates an admission note summing up the patient's medical history. When doing that, the assistant doctor retrieves information from various sources: from the conversation with the patient, the evaluation letter that was written by the NEV, and from the epicrise from Sørlandet hospital in Kristiansand that includes a summary of the illness' history. In the admission notes, he also includes a status-presence of the medical condition.

   The assistant doctor uses the F1 form (see Appendix D. 1 for viewing the form) in order to signal to the nurse that no medicine should be given to the patient. This form is referred to as the medical-curve, and is being used for communication between the doctors and the nurses. The doctors write information about the type and quantity of medication that should be given to the patient, and the nurse retrieves these instructions when handing out medicines to the patients. In our case, since Mr. Smith will have to go through the UPDRS test tomorrow; the assistant doctor fills the number "0" in the F1 form, indicating to the nurse that no medicine should be given to the patient.

   If the assistant doctor notices that there is a need for supplementary examinations, he registers them in the F3.0[33] (see Appendices D. 2- D. 3 for viewing the form), which includes a list of the examinations on one side of the paper and the blood tests on the other side. Then he orders these by filling inn internal referral letters, and handing them over to the post-secretaries who are responsible for sending letters to the various clinics.

[33] The F3.1 form: Plan- examinations and blood tests.

Thereafter, the secretary transcribes the dictation of the admission-note into DocuLive EPR, and the doctor corrects, verifies and signs the note.
During the first day, the primary care nurse[34] makes sure that Mr. Smith attends his pre-scheduled appointments to the clinics, where various examinations are conducted (e.g., CT, MR). Since it is difficult to makes all the appointments to the examinations in the various clinics in one day, Mr. Smith will attend the rest of the appointments during the second and third day if needed.

On the second or the third day, when the pre-operative diagnostic tests were completed, the doctors gather at 8:00 AM for their morning meeting. Here they refer to the new patients that came yesterday and summarize their findings. The assistant doctor that was responsible for Mr. Smith, introduces the patient, his medical condition, and medicines that he is taking. Now, when the patient had gone through some of the examinations, the assistant doctor has the possibility to express his opinion about the patient's medical condition, and whether an operation is relevant for the patient. As mentioned previously, the first level of decision-making was based on the paper-based referral letter without meeting or examining the patient. The examinations that were pre-ordered in advance by the head doctor were based on the referral letter from Sørlandet hospital from Kristiansand. Therefore, after meeting the patient, the assistant doctor might notice that either the information was incorrect or imprecise (e.g., that the patient does not suffer from Parkinsons Disease, but rather has symptoms that resemble PD), or that the patient's medical condition has changed during the pre-operative time (the time between receiving the referral letter and admitting the patient). The referral letter might have been sent to the Neurology department six month earlier, and while waiting for a reply, the patient's medical condition might have changed. So, if the assistant doctor hears, for instance, suspicious sounds in the patient's heart, he must send the patient to the Heart Medical department in order to fully complete the pre-operative examinations. This is the second level of decision-making, and it is based on the meeting with the patient.

In the morning, the nurse visits her patients and gives them their medicines. Looking at the F1 form, which is the medical-curve (containing instructions about the medications), she see that Mr. Smith is not supposed to receive his medicine (Levodopa). She takes out the F1 form from the curve-book and signs her initials. This way, she signals that the instructions have been fulfilled and no medicine was given to Mr. Smith. Then she carefully follows the changes with the patient by filling in a special form, called the "Parkinsons form" (see Appendix D. 4 for viewing the form). In this form, the nurse registers the medical condition of Mr. Smith, describing it as either "off" or "on". "Off" means the Mr. Smith's muscles are very stiff, while "on" implies that the medicine started affecting his body, and his muscles are therefore soft. The nurse registers the information in the form, each hour during the whole day.

At 9:15 AM, there is a pre-round meeting, which is an interdisciplinary meeting for the assistant doctors, one (or more) of the head doctors, the head nurse, the post secretary and the primary care nurses. During this meeting, the assistant doctor that was responsible for Mr. Smith receives an updated report

[34] The primary care nurse is responsible for the "total nursing care" of a given number of patients. In addition, a primary care nurse might do the administrative and operational work of the head nurse if needed and assist nursing personnel.

from the primary care nurse about the patient. Looking at the F3.1, which includes a list of the examinations on one side, the assistant doctor sums up the examinations that have been conducted, and verifies with the other doctors if there is a need for additional examinations. The head doctor will ask the assistant doctor if he made sure that the patient will not be given any medicine.

After the pre-round meeting (at about 10:00 AM), the head doctor will go for the ward rounds and will see Mr. Smith. At this point, Mr. Smith had been without his medicine (Levodopa) since midnight and until 10:00 AM the day after. This way, he reaches the worst condition/state where his body is extremely stiff. This represents the condition/state that Mr. Smith will reach in ten years if he will not be operated upon. The head doctor looks at the "Parkinsons form" that the nurse has been filling in since the morning in order to follow with the changes in the patient's condition. Then the head doctor gives Mr. Smith a medicine which is exactly like the Levodopa but has rapid effect on the body. After approximately two hours, the head doctor visits Mr. Smith again, in order to see the effect of the medicine on his body. In the meantime, the nurse keeps following up with the patient's medical condition using the Parkinsons form.

At the end of this examination, the head doctor compares the medical condition of the patient with and without medicines (before and after). Using the Parkinson' form, the head doctor can see for how long a time the medicine affected Mr. Smith. In addition to this information, the head doctor receives results from the various examinations, and collects information from a general evaluation about the quality of the patient's life (his everyday level of functioning), his motivation and anticipated prospective benefits from the operation. Having all this information provides the head doctor with a comprehensive overview over the patient's medical condition. This will be used as background information for evaluating the best treatment for the patient, and clarifying the benefits and disadvantages of continuing with medicines, versus conducting an operation.

In principle, it is the head doctor who determines the final decision on the third day. However, if he finds that his conclusion is different from the assistant doctor's conclusion, he might contact the assistant doctor for a discussion. There are no permanent routines for this discussion, and it rather depends on the patient's case and on the work practice that is used.
The collection of the necessary data about the patient's medical condition is completed. Once the diagnosis is completed and the illness is identified, the next step is the decision-making including mapping prospective interventions. At this stage, the patient has not been accepted yet for an operation, but only for evaluation at the NKI department.

At this stage there are three possible situations. The patient might either be totally excluded from having an operation, due to his medical background (former operations), or having other perilous illnesses. In these cases, it is obvious that the patient will not have any benefits from the operation. The second possible situation is that the neurologists are still not sure about the findings (in a case where the patient is functioning very well in his everyday life except for having low symptoms of shivering) and therefore ask the patient to come back for control in 3 or 6 months, when new examinations will be taken. The last situation is where the neurologists are sure that the patient will have clear prospective benefits

from the operation, and therefore decide to discuss this case with the surgeons. The patient is discharged and asked to wait for an answer.

10. In our optimal case, the process of the diagnostic tests (examinations) was completed without any complications. In the morning meeting, a detailed report will be given about the patients that are admitted to the department while the patients that are to be discharged are discussed briefly. In this case, the head doctor mentions Mr. Smith's diagnosis, and the final decision for applying for operation. This way, both the assistant doctor that was responsible for Mr. Smith, and the rest of the doctors on duty, are informed about the final decision. Before discharging Mr. Smith, he is being informed about the decision which implies that he is a candidate for operation in the Neurosurgery department, and is being asked to wait for a reply. At this stage, Mr. Smith is a candidate for an operation, but it is still uncertain whether he will receive an operation or not.

D. Discharge of a patient from the Neurology department:

All the relevant documents that are available are sent to the responsible doctor, so that he can dictate a discharge note. Then, the documents and the paper record are sent to the secretary who transcribes the discharge note into DocuLive. The doctor corrects, verifies and signs the note. Then the secretary straightens up the paper record (shredding incomplete blood test results from EROS etc.). The various laboratory results are sent to the responsible head doctor, so that he can dictate the final epicrise.

When it comes to a Parkinsons case, the neurologists often wait before writing the final epicrise until after the Parkinsons meeting with the surgeons in order to include a summary of the decisions that has been reached. In other words, this epicrise usually includes an evaluation when the patient was admitted to the department, an evaluation from the common meeting with the Neurosurgery department (NKI), and a summary of the final decisions that have been taken.

The secretary receives all the documents (including various results of examinations), and transcribes the epicrise into DocuLive EPR. When the head doctor has finished correcting, verifying and signing the epicrise, the secretary sends copies to the health care organisation that transferred the patient to Rikshospitalet. In our case, one copy is sent to Sørlandet hospital in Kristiansand, and one to Mr. Smith's primary doctor in Mandal. The secretary then carries out the last and final straightening up procedures before sending the paper record back to the archive.

Once the patient is discharged from the NEV, all the information and the various forms are gathered and placed in the paper record. The examination results are sent to the NEV, and the secretaries print out copies of the electronic information that is in DocuLive and put it in the paper record. Hence, there is a fragmentation of the information where some parts exist in an electronic form, while others in a paper-based form.

The procedure of the diagnostic tests is completed and the patient is now a possible candidate for an operation in the Neurosurgery department.

E. Neurology department sends a request for an operation to Neurosurgery

11. In our case, the responsible head doctor at the NEV decides to send a request to operate on Mr. Smith. When writing the epicrise where he summarizes the diagnostic tests that were conducted, the head doctor includes a request to operate on the patient. In other words, the epicrise in this case is being used as a referral letter. In addition, the head doctor registers the name of the patient in a special list that provides an overview over all the Parkinsons patients that can possibly be

operated. These patients will be discussed in the Parkinsons meeting, which is an interdepartmental meeting that takes place on the first Monday, each month. In the meantime, the secretary at the NEV department sends a copy of the epicrise to the NKI department. In a case without previous medical treatments at Rikshospitalet, as in Mr. Smith's case, the patient record is not being sent since it can be accessed electronically using DocuLive EPR. Then the epicrise is sent further to the surgeons that deal with Parkinsons surgery. One of the Parkinsons surgeons fills out an evaluation form. There he includes information about the diagnosis, how urgent the operation is (Parkinsons cases are often not so urgent since it is a long term disease), and whether the operation must be conducted by special surgeons (which is the case with PD). Once that is completed, the surgeon sends back the epicrise together with the evaluation form, to the application office. The application office registers the patient in a so-called "open waiting list" in PiMS (meaning that it is not clear yet if the patient will receive an operation or not).

F. Parkinsons meeting

12. On the first Monday of each month (16:00 PM), there is a Parkinsons meeting. This is an interdepartmental meeting, and the participants are three head doctors from the NEV and two Parkinsons surgeons from the NKI department.

    After collecting all this information, the neurologists that are responsible for Parkinsons take the patients' paper record, the list of the prospective patients for operations, and all the relevant documents, and have a meeting with the surgeons from NKI. Starting at the top of the list (choosing the patient that has the top priority), they discuss the various patients. Here they present all the information they found about the patient including the history of the patient's medical condition, the quality of his or her life (functioning level), the patient's motivation, and the anticipated benefits from the operation.

    If the patient is too old, and has other additional illnesses (a heart problem, blood pressure, diabetes, for example) then there is a higher risk involved in operating on the patient, the danger that the patient will not be able to carry the operation. The doctor also considers the amount of medicines that the patient consumes. So if for instance the patient consumes 300 milligrams, they can decrease the amount of medicine to 700 milligrams, which might help the patient and prevent the need to operate. But if, on the other hand, the patient has been consuming 1500 milligrams, then something else must be done. So, the operation is the last resort (the last way out). The two Parkinsons surgeons from NKI contribute with prospective ideas about surgical treatment. This is a critical part of taking final decisions for conducting an operation. Finally, after this comprehensive evaluation, if the neurologists and the surgeons agree that the patient will have clear benefits from the operation, then the final discussion will be taken during this meeting. A list of all the patients discussed during the meeting is created. This list includes information about which patients have been accepted for operation, and which patients were rejected for various reasons. The patients who have been accepted for operation are then registered on a waiting list, and a copy of the list is sent to the patient coordinator who is responsible for the adult units at the NKI.

13. The patient coordinator from the NEV department then sends a letter to the patient informing him that he has been accepted for an operation at the

Neurosurgery department at Rikshospitalet, and that he has been registered on a waiting list. The patient coordinator contacts the patient by the telephone, sending a letter, or by inviting him for a conference with the surgeon, depending on what he prefers.

G. Planning the operation

A Parkinsons operation implies implantation of a stimulator, and it is a highly complex surgery that can be conducted by only two Parkinsons specialists (surgeons) in the Neurosurgery department. Parkinsons operations can and must be planned very well in advance. It is such a complicated operation, that it requires the presence of both Parkinsons surgeons. Planning a schedule for Parkinsons operations is done through cooperation between the patient coordinator and the Parkinsons surgeons.
The surgeons and the patient coordinator receive information about the number of the Parkinsons operations that they can conduct for example during the spring. In other words, the number of the Parkinsons operations depends on the budget. So if, for instance, they are informed in January that they are allowed to perform ten Parkinsons operations up to the summer, they try to frame a plan for the spring where they plot in ten operations. Wednesdays are Parkinsons days at the NKI department, and on this day, the patient coordinator meets the surgeons in order to pre-plan a schedule for Parkinsons operations. They follow the waiting list, and choose the first ten patients who are registered at the top of the list to be the ones to receive an operation. Then, they decide in which month and on what day the operation will take place.

There are standard routines that are used for other types of operations that are less complicated. Following these routines, the patient coordinator usually receives information from the surgeons where they write approximately in which month they can conduct each operation. Using this information, the patient coordinator frames a proposal for the operation schedule, and meets the head nurse from the operation theatre in order to discuss the proposal. When this is done, she delivers her proposal to the head of the department, two surgeons from the department, and to the head nurses from all the units. Then, during the operation meetings on Thursdays, they gather to discuss and confirm the operations schedule that was proposed by the patient coordinator. They make the adjustments that are needed and update the final operation plan according to which surgeons are available, and try to plot in operations that were postponed from last week. At this point, the patients that are to be operated upon have already been informed, so this meeting is conducted in order to ensure that the new final operation schedule is well planned and realistic.

Parkinsons operations, on the other hand, are highly complex. They usually demand a whole operation theatre, and the whole day (a standard operation without complication takes six to eight hours). Because Parkinsons operations are well planned in advance, these standard routines for planning operation schedules are not used in these cases, and they are not put on the agenda of the weekly meetings. Those operations are planned approximately half a year in advance, and they are changed only if a new resolution is being taken, for example, and the NKI department receives a message that they can operate on more patients before the summer.

After the meeting between the Parkinsons surgeons and the patient coordinator, the patient coordinator updates the operation plan in Albert (the information schedule for the operations). This implies registering dates for operations, types of operation, type of patients and their diagnoses, and the names of the surgeons. While doing that, the patient coordinator double checks to be sure that all the examinations have been pre-ordered. If

for instance she sees in the epicrise that the patient suffers from a heart problem, which might cause to complications during the operation, she consults the surgeons and decides whether additional medical supervision is needed from other departments (e.g. the heart section in the Heart Medical department). If this is the case, the surgeons write the referral letters that are needed, and the patient coordinator requests the examinations. The patient is then asked to come to the department a week in advance, depending on the examinations that are needed, in order to complete the diagnostic tests before the operation (This happens rarely since the patients usually come from the NEV department after receiving complete diagnostic tests.)

In addition, patient coordinator fetches the epicrises that were sent from the NEV and belongs to the patients that will have operations, and writes on each epicrise the name of the department and the unit to which the patient will be admitted, in addition to the admission date, and point in time.

Once that is accomplished, the patient coordinator sends all the documents back to the application office. By following the patient coordinator's hand-written notes on the epicrises, they can both update the information in PiMS, and send the letters to the patients. This letter defers from the first one that was sent from the NEV were the patient was merely informed about acceptance to an operation. This letter includes more detailed information about the operation date, and the admission date (which is usually one or two days before the operation.

Then the patient coordinator and the surgeons have lists for; Untreated applications: a list of all Parkinsons patients that has been sent to the outpatient clinic but still needs to be evaluated; a list of all patients that have been in the outpatient clinic and are requested for diagnostic tests (examinations) at the NEV department; and a list of all patients that have been accepted for operation. These lists are not from Albert, but Excel sheets. When the patient coordinator frames a final schedule for the autumn, she sends a copy of this to the patient coordinator at the NEV department, so that she will know that one or two days after the operation, the patient will be transferred to the NEV department for recovery. In summary, the information flows between the two departments through the patient coordinators at both sides. In addition, the information about which patient had been accepted flows through the surgeons and to the neurologists during the Parkinsons meeting.

Another channel for the information flow is through the head nurses at both sides. After the Parkinsons operation, the head nurse from the respective adult unit at the NKI department, contacts the head nurse from the NEV department, and informs her that they have a Parkinsons patient that will be transferred to the NEV for recovery. This is usually done one or two days before transferring the patient, using the telephone as a communication channel. This additional channel is important since Parkinsons operations are so complex and complications might arise after the operation, and it is difficult to pre-plan in advance when patients will be transferred.

Beside the list that the patient coordinator sends to the various actors a week before the operation, they have the possibility to retrieve information from Albert. The patient coordinator at the NEV, the head nurse from the operation room, and the secretaries and the head nurses at the NKI, have reading-access to Albert. This implies that they all have the possibility to retrieve information from this system in advance, before receiving it from schedule that the patient coordinator sends to them a week before the operation. On Thursday, a week before the operation date, the head of the department, two surgeons from the department, the head nurses from all the units, and the patient coordinator gather

for an operation meeting in order to ensure that the final schedule for operations for the next week is complete and well planned.

H. Admission to the Neurosurgery before an operation

A day before the operation, the patient comes to the NKI, to the adult unit nr. 1. The head nurse in cooperation with the primary care nurses is responsible for updating the new patient list[35] and printing it out before the morning report to the nurses. They are also responsible for providing rooms for the new patients. At 7:00 AM, the nurses gather for their morning report. The nurse who had the night shift gives her updating report, while the nurses that are on duty this morning write key words in their new and updated patient list. The report includes various information such as: the historical background of the new patients, summing up the patient's medical condition (both physically and psychologically), which medicines should be given and which examinations are or should be ordered, which patients will be discharged or transferred etc. The head nurse then adds updated information about the operation schedule for the following day (e.g., for possible postponement/changes). Finally, the new patients are being divided between the nurses on duty.

The nurse that was chosen to be in charge of Mr. Smith makes the last preparations before meeting him for a conversation in one of the available meeting rooms. First, she fetches the referral letter from the shelf labeled "admitted patients". Then she prepares a workbook for this new patient, which will contain the nurses' documentation. She fills up the G1 form (General Information) [36] while simultaneously scanning and retrieving information from the referral letter. Hereafter, she prepares new labels for the patient's bed, and a special label that the patient will wear on his hand. She also prepares the "evaluation form" that the patient is supposed to fill in when he is discharged. In this form, the patient is invited to provide feedback to the department.

Before an operation, the patient must have blood tests that are not older than 3 days (72 hours). Since Mr. Smith will have the operation on the next day, she phones the laboratory and asks them to accept the patient an emergency case (this in order to prevent the patient from spending the whole day at the laboratory). When she receives confirmation to do so, she fills in and sends the blood-test requisition using the pipe-post. Later when she meets the patient, she will ask him to go down to the outpatient clinic for this test.

The nurse then goes to the waiting room to meet the patient. Together they find a meeting room. At this point, the nurse informs the patient about the treatment plan and the operation that is to be conducted the day after. The nurse then shows the patient his room, and labels the patient's bed with his name and personal number.

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[35] Patient-lists: This list gives an overview of all the patients that are hospitalized in each ward. The list accumulates basic information such as: the name of the patients, their birthdays, and room and bed numbers. In addition, the list includes key words concerning medical condition (e.g. historical background, current diagnosis, and prescribed drugs), practical information (e.g. appointments for examinations), and non-medical information (e.g. information about the patient's social and psychological condition etc.).

[36] The G1 form, General Information: especially relevant for nursing, e.g. subset of patient's demographics, diagnoses, allergies, and disabilities. The items were organised to support existing, de facto information flow in data or use at handover.

Once that is completed, the nurse goes back to the ward and writes an admission note (G2 form[37]) in DocuLive, while shuffling through various documents. She retrieves information from various sources: from the copy of the referral letter, the G1 form (which contains general information about the patient), her personal notes that she took during the conversation with the patient, the patient list (the notes that she wrote during the pre-round meeting), and from her memory. When she completes writing the note, she verifies it, signs and prints it.

Thereafter, the F2.03 form, "Message to operation-anaesthesia" (Melding til operasjon- anestesi) is being filled in. Thereafter, one of the post secretaries prepares all the forms that the anaesthesia doctor should fill out and sticks the patient's bar code label on the forms. She puts all the forms in a plastic cover, and lays them down on the left side, on the table that is in the hallway between the ward and the expedition. An anaesthesia doctor comes up to the NKI, at around 14:00 or 15:00 o'clock, in order to provide anaesthesia supervision for all the patients that will have operations a day after. He follows a list that the personnel at the operation rooms and the anaesthesia doctors generated from the F2.03 forms. The anaesthesia doctor talks to each patient in order to prepare him both physically and psychologically for the operation and the procedure around this (e.g. narcosis). The nurse makes sure that the patient fasts during the day before the operation. This means that he is not allowed any intake of food substitutes or fluid into his stomach. This is in order to prevent from complications under the operation.

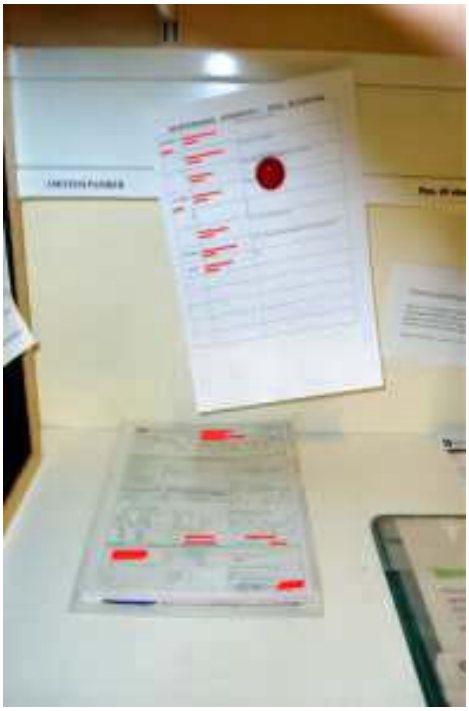


Figure 5.2.6- Anaesthesia-forms

I. Operation

14. The operation involves transplanting a stimulator in the brain that will help stop shivering. An operation without complication takes 6 to 8 hours.
    Operations require the collaboration of an extensive medical team. For an operation to work, surgeons, angiologists, radiologists, anaesthetists, technicians and nurses, have to cooperate and attune their activities to one another[38].
    On the 22nd of May 2003, at 7:10 AM, a morning meeting is conducted. At this meeting, the head of the department, all the doctors and the head nurses from all the units, meet together with the staff from the anaesthesia and operation theatre. They discuss only the new patients that came to the department, giving a report of what happened during the last day. In addition to this, they plan the operations for the following day.

    The responsible nurse prepares the relevant documents. This implies putting the operation description in a plastic cover, preparing the patient record and the workbook that contains the nurses' notes. When everything is ready, the nurse follows Mr. Smith to the operation theatre.

[37] G2, Admission: Statement about the patient at admission and reason for hospitalization as detailed assessment according to 10 specified functional areas of human functioning.
[38] Complexities, Social Studies of Knowledge Practice. John Law and Anne Marie Mol. Duke University Press. Durhan & London, 2002, p.231

Such a complex operation involves many pre-operative preparations, but due to the scope of this case, I will not to go into the details. In our optimal case, Mr. Smith's operation went without any complications, and a stimulator was transplanted in his brain. Once the operation is completed, a description of the operation is being dictated by the surgeon who conducted the operation. This epicrise includes an exact description of the way the operation proceeded. Then the secretary transcribe the epicrise and sends one copy to the NEV department, one to Sørlandet hospital in Kristiansand, and one to Mr. Smith's primary doctor (since they were the ones who transferred Mr. Smith to Rikshospitalet). After the operation, in the evening, the stimulator is being turned on and starts functioning.

J. Transferring the patient to the Neurology department for recovery and control

15. The patient stays for approximately three or four days after the operation in the Intensive Care Unit (ICU) at the NKI. When the patient starts recovery, he is sent down to the NEV department to the regular unit (not in the ICU). Patients that are transferred from the NKI are usually list-patients, meaning they are already registered on the waiting list. This implies that the NEV department has been informed in advance about the patients that will be transferred.

    The secretary at the NEV department registers the admitted patient in PiMS, and he will stay at the NEV for two weeks. During this period, the doctors at the NEV will remove the stitches from the patient, configure the stimulator and the medicines, and discharge him. If there are any complexities that appear with the stimulator (e.g., it is not laying correctly, or not functioning correctly), then the neurologists consult the surgeons at the NKI.

K. Discharge of the patient from Neurology department

16. Mr. Smith is being discharged from the NEV department and is asked to come back for control.

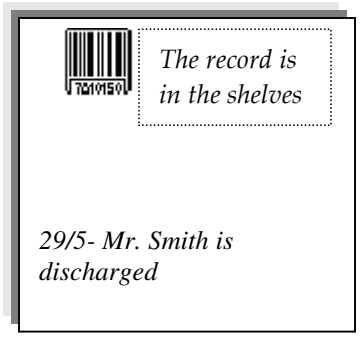
    It is in the pre-round meetings that the doctors decide whether the patient should be discharged or not. Information is being retrieved from various paper-based sources, electronic sources and from the doctors' memory. [Paper sources include: Curve-book, ICD10, Workbooks, and felleskatalogen. Clinical Information Systems (CIS) in the computer include: DL, ICD10, EROS, PACS (radiological pictures, MR and CT), RISS, PiMS, local internal DB connected to the outpatient clinic]. In addition, they receive updated information from the nurses about the follow-up process and the existing medical (both physical and psychological) condition of the patient. The doctor that sits with the curve-book writes the following information in the F3.1 form in the side of the examinations (Plan-examinations and blood-tests):

    "R: 16/5-03" //date for Discharge (Reisen)
    "D: -------- " //code for the Diagnose
    "Ktr: --------" //date for Control (further follow up).

    The nurse that was in charge of the patient fills in the A5 form[39] (see Appendices D. 5- D. 6 for viewing the form), which is the nursing discharge summery. Then,

[39] The A5 form, Nursing Discharge Summery: Is a resume of solved problems during hospitalization and specification of identified problems for further follow-up by nurses in other institutions or levels of care at discharge.

the nurse takes out from the patient workbook the following forms: G1 form- Patient information, and the G4 form- Nursing report. Then she writes that the patient has been discharged from the department, and makes copies of these forms. She puts these copies in a special file/binders that contains only forms of discharged patients. On the cover there is a label with: "Discharged patients". Hereafter, the nurse takes out all the nurses' notes from the patient's workbook including the G4 and the G1, and wraps them with a thin white cover (which is actually just a piece of paper).



- On the left side in the top of the cover, the patient's barcode-encoded ID sticker is attached to the cover.
- A couple of lines under this bar-code, the discharge date of the patient is written.
- On the right side in the top of this paper a hand written message is written saying that the patient record is in the shelves.

The nurse puts the white cover with the documents in a special place on the table that is outside the on-duty room in the ward. At this point, all the relevant documents that are available are sent to the doctor, so that he will be able to dictate a discharge note, summing up the discussion and the decisions that were made during the pre-round meeting (including the follow up program for the patient). If the doctor that is in charged of the patients that will be discharged is not on duty, then another doctor take the responsibility to sum up the discussion and write a discharge note. But it is the responsible doctor who will write the final epicrise. The paper record and the cassette (that contains the dictate) are sent to the secretaries, and they transcribe the discharge note into DocuLive. Then they straighten up the paper record (shredding incomplete blood test results from Eros etc.). When this is completed, the responsible doctor corrects the note, verifies and signs it. All the documents, together with the results of the examinations that the responsible doctor ordered are sent to the doctor so that he will dictate the final epicrise. When it comes to a Parkinsons case, the neurologists often postpone dictating the final epicrise until after the Parkinsons meeting with the surgeons in order to include the conclusions from the meeting. The secretary transcribes the epicrise in DocuLive and sends it to the doctor for correction, verification and signature. Then the secretaries receive all the documents (including various examination results) and carry out the last and final procedures before sending the paper record back to the archive (see figure 5.2.7- Trolley).

Figure 5.2.7- Trolley

L. Control after operation (Neurology)

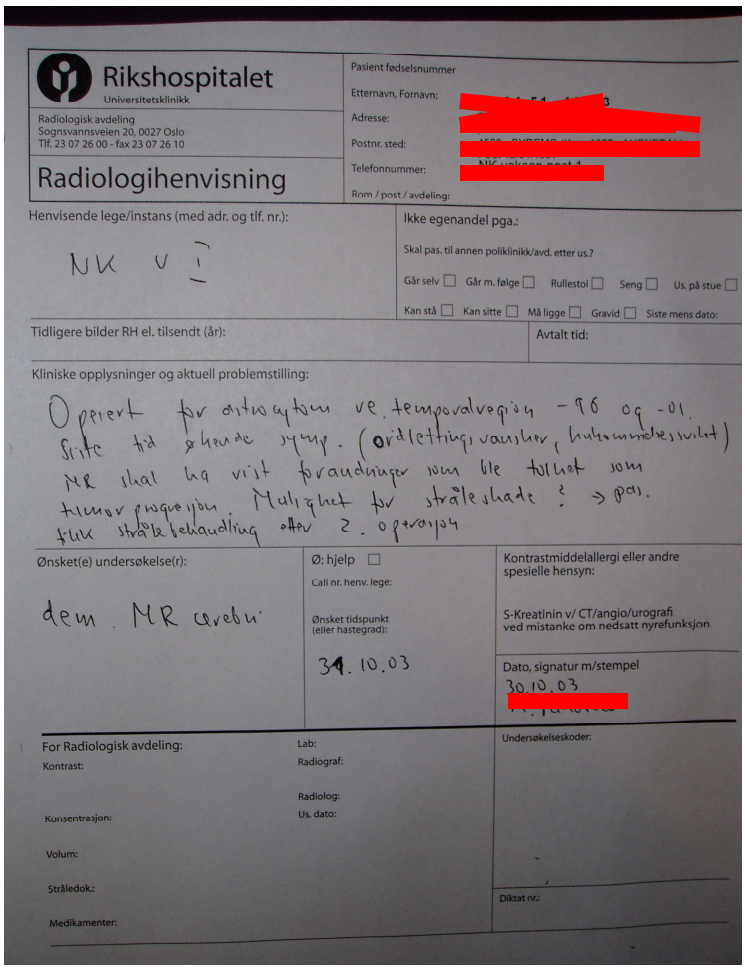
17. The patient comes to the NEV department for post-operative procedures, including control and further follow-up, after 3 months, and then after 6, 9 and 12 months. After one year, the patient is supposed to come for control once in a year.

The patient is being controlled in order to review whether the effect and results of the operation and to configure the stimulator.

5. 3 – Internal Electronic Referral letters

In the following, I will first describe the implementation of the pilot-project of electronic referral letters. Subsequently, I will provide a narrative description followed by a graphical representation of the work practice prior to the introduction of the electronic referral letters. Thereafter I will describe the implementation process of the project, and outline the new work practice. Then, I describe the implications of the project, and compare between the situation before and after the transformation to electronic referral letters. Finally, I will briefly describe some of the overall prospective goals for further development of the electronic referral letters project.

First and foremost I will begin with a general definition of an external referral letter. The referral letter is a reference from the primary doctors or the hospital, and it is being sent to the doctor that is responsible to evaluate the application. It is a central element by which the health care providers collaborate with other care providers within the hospital and outside the hospital. Sending referral letters to other department within the hospital or between health care organisations is usually part of the hospitalization routine.


Rikshospitalet
Universitetsklinikk

Radiologisk avdeling
Sognsvannsveien 20, 0027 Oslo
Tlf. 23 07 26 00 - fax 23 07 26 10

Radiologihenvisning

Pasient fødselsnummer
Etternavn, Fornavn:
Adresse:
Postnr. sted:
Telefonnummer:
Rom / post / avdeling:

Henvisende lege/instans (med adr. og tlf. nr.):
NK V

Ikke egenandel pga.:
Skal pas. til annen poliklinikk/avd. etter us.?
Går selv ☐ Går m. følge ☐ Rullestol ☐ Seng ☐ Us. på stue ☐
Kan stå ☐ Kan sitte ☐ Må ligge ☐ Gravid ☐ Siste mens dato:

Tidligere bilder RH el. tilsendt (år):
Avtalt tid:

Kliniske opplysninger og aktuell problemstilling:
Operert for ortoptom ve. temporalregion -96 og -01.
Siste tid økende symp. (dobbeltsyn, vansker, hukommelsessvikt)
MR skal ha vist forandringer som ble tolket som
tumor progresjon. Mulighet for stråleskade ? → pas.
fikk strålebehandling etter 2. operasjon

Ønsket(e) undersøkelse(r):
dem. MR cerebri

Ø: hjelp ☐
Call nr. henv. lege:
Ønsket tidspunkt (elier hastegrad):
31.10.03

Kontrastmiddelallergi eller andre spesielle hensyn:
S-Kreatinin v/ CT/angio/urografi ved mistanke om nedsatt nyrefunksjon
Dato, signatur m/stempel
30.10.03

For Radiologisk avdeling:
Kontrast:
Konsentrasjon:
Volum:
Stråledok.:
Medikamenter:
Lab:
Radiograf:
Radiolog:
Us. dato:
Undersøkelseskoder:
Diktat nr.:

Figure 5.3.1: A paper-based version of a referral letter (hand written).

The electronic referral letter is a pilot project conducted by the IT department. This project expands the Electronic Patient Record (EPR), DocuLive, by adding a new function that gives the possibility to send internal referral letters electronically within the hospital. There are two types of referral letters: one type is from specialists (stored in chapter B2[40]), and the other type is general and simpler referral letters in chapter H[41]. I chose to limit the scope of my study to the part of the pilot project that deals with general referral letters. The Neurology department was chosen to be the sender for chapter H, and the Physiotherapy department was the receiver. As illustrated in Figure 5.3.1 and Figure 5.3.2, the electronic version was based upon the paper-based version of a referral letter (even though Figure 5.2.1 shows a referral letter to the radiology, it is very similar to the one that is used for the physiotherapy department). The physiotherapists write their documentations in chapter H1 (Physiotherapy).

The electronic version of the referral letters has an additional function that includes linking the note that was written in B1[42] to both the documentation in H1, and to the referral letter in B2[43].

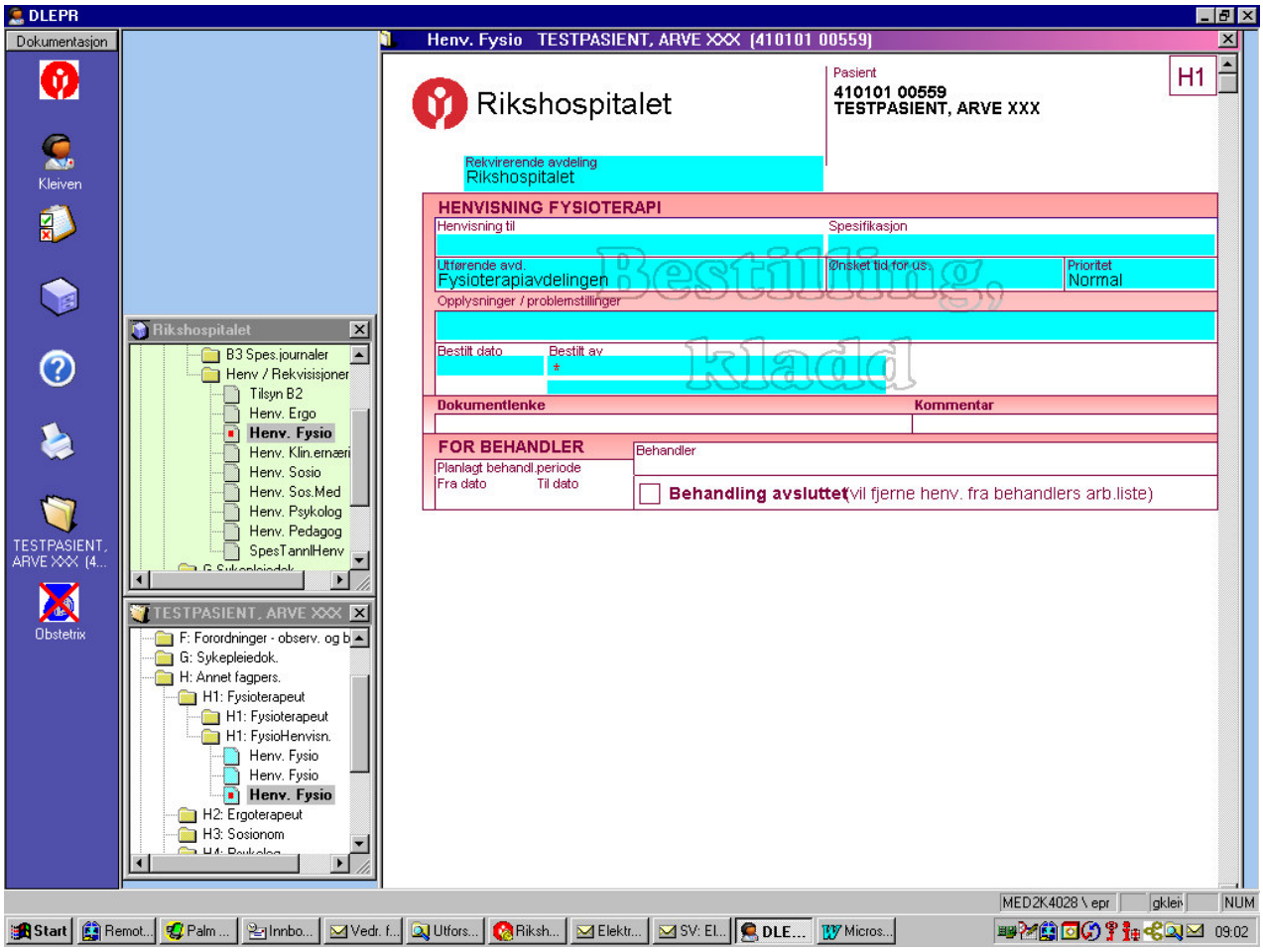


Figure 5.3.2: The electronic version of a referral letter (mapped after the paper version)

[40] B2: "Results of/reply of internal referral letters". In Norwegian: Spesialistundersøkelse, henvisning/svar.
[41] H: "Report and notes from other health care providers" (H1: Physiotherapy)
[42] B1: "løpende journal"
[43] B2: "Resultat av svar på interne henvisning"

The trajectory of writing and sending a referral letter might be seen as a simple event. However, this is a distributed trajectory that accumulates articulation work and interaction between heterogeneous health care providers, various artifacts etc. It involves evaluations and decisions of physicians, administration work of secretaries and so forth. When a referral letter is being sent by the internal mail, it means that the secretary place the letter in the shelf that is labeled with "Internal mail". A transporter would come and pick them up twice or three times each day, and distributes them to the various clinics respectively. Then the secretaries at the outpatient clinics distribute the referral letters to the health personnel that are responsible for registering appointments. Having such a long chain of actors and activities causes to the problematic situation of delays where it takes one whole day before a referral letter reaches the outpatient clinic that is in the first floor (except emergency-cases where the secretary fax or walks to the clinic with the referral letter). Due to this complex articulation work, there are many handwritten referral letters that are being lost along the way, especially roentgen referral letters. In fact, what often happens is that referral letters are misplaced and end up in the wrong place. In these cases, the secretaries wait for 2 or 3 days, and then call outpatient clinic to investigate why the patient did not receive any appointment yet. Often, outpatient clinics claim that they never received the referral letter. This has caused to a situation where some of the secretaries (e.g. at Neurosurgery) adapted rigid routines where they take copies of all the referral letters that they send and store them in a special file. This, in order to have a proof, or to be able to document, that they sent the referral letter[44]. However, these redundant and double routines do not help since a new referral letter must be written anyway, and the patient must stand in the queue all over again.

I had the opportunity to follow closely the implementation of the pilot project that was conducted between the Neurology and the Physiotherapy department. This includes participation in the various meetings and teaching sessions that were conducted in both departments, as well as conducting observations and interviews with the participants. In this section, I will follow the trajectory of a referral letter, and will show how the introduction of the electronic referral letter affected and altered the work practice that is embedded in the trajectory of sending a referral letter. In addition, I will show how the introduction of the electronic referral letter solved some of the existing problems, but at the same time, it gave rise to new tasks and challenges, new weak spots and dilemmas.

5. 3. 1 – The work practice before

In order to illustrate the trajectory, I choose to outline the sequence of activities prior to the introduction of the electronic referral letters.

The decision concerning sending patients to physiotherapy is very often taken during the pre-round meeting that the doctors at the NEV have every morning, but this might also be done during the ward round together with the patient. The decision is based on a process of employing the physician's fingertip knowledge, consultation with other physicians, and the patient's medical condition.

1. One of the doctors who sit with the binders that contain empty referral letterforms hands over to the responsible doctor an empty form.

[44] The secretaries at the Neurology department do not take copies of referral letters, so this work practice varies, depending on decisions taken by the head of the department.

2. The other doctor who sits with the curve-book that contains the barcode-encoded ID stickers for the patients, hands over to the responsible doctor a label with the patient's personal number.
3. The responsible doctor then attaches the patients' barcode-encoded ID sticker to the form, fills up the form by writing the type of examination that is needed and stamping the form with his name and the name of the department (e.g.: "Neurology, Dr. S").
4. The doctor hands over the referral letter to the primary care nurse (or to one of the other nurses who are present).
5. After the meeting, the primary care nurse hands over the referral letter to the post-secretary, who places it on a shelf labeled with "physiotherapy".
6. Manual routines exist in order to keep control over which referral letters has been sent (secretaries take copies of the referral letters and put them in a special cover for "copies of referral letter").
7. Twice a day, a physiotherapist comes to the NEV department to see the patients, and at the same time to fetch the referral letters from the shelf. Each day, there is one physiotherapist that is responsible for the patients in the NEV and NKI departments.
8. Each morning, there are four physiotherapists that are responsible for the division of labour. They distribute the referral letters respectively between the six groups of the physiotherapists. The physiotherapy department is divided into six sections: Surgery/medicine, Heart/Lung, Children/Women, Neurology, Orthopedic, and Rheumatology. The section that deals with neurological afflictions cooperates with five departments: the neurology department, neurosurgery, plastic surgery, skin-department, and the outpatient clinic. So, the referral letters are first distributed according to which department sent them, and are placed respectively on the tables that each group has (e.g. all the referral letters that are sent from the NEV and NKI departments, are placed in the same pile of papers on one table). Then when the physiotherapists have a morning meeting, each group can see how big the pile of referral letters on their table is, and divide the workload respectively among the physiotherapists who are on duty. A list is being generated providing an overview over the current workload. Thereafter, depending on the urgency, each physiotherapist visits his patients in the various departments and conducts the requested treatment.
9. When this is completed, the physiotherapist writes a reply-note using DocuLive, and signs on the paper-based referral letter in order to indicate that the treatment has been completed.
10. Then, the physiotherapist prints out all the documentation that was written in DocuLive during the treatments' period, and attaches them to the referral letter.
11. The doctor at the NEV retrieves (reads) the reply-note from the physiotherapy department using DocuLive.

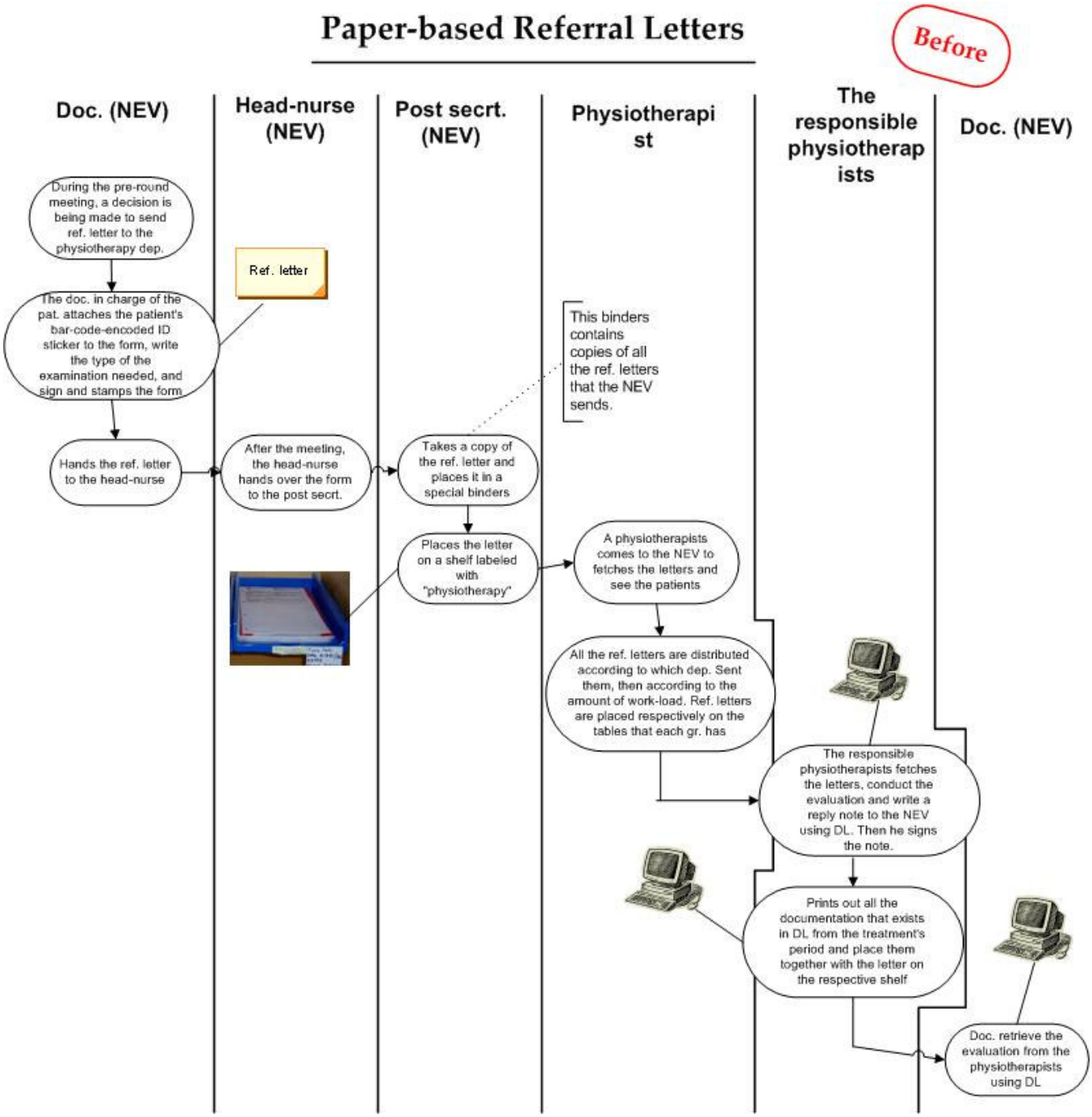


Figure 5.3.3: The work practice prior to the implementation of the electronic referral letters

5. 3. 2 – The implementation process

The implementation process of this pilot project included several events that had been conducted pertinent to the processes studied. In this part I would like to introduce the sequence of meetings in a chronological order and briefly describe the content of each meeting. Participating in most of the meetings allowed me to gain a richer insight of how complex it is to implement an apparently small change as such.

On the 5th of May 2003, a letter was sent from the IT department to the head of the neurology department, introducing the new functionality that will be integrated in DocuLive.

Three days later, on the 8th of May, a general demo meeting was held with the NEV department. Here, the IT department introduced the main goals that have been set up for year 2007. This included introducing CSAM project (Clinical Systems All Merged), which is a clinical portal that will replace today's paper record. This portal is to offer new information services related to patients, the personnel, and external customer. In addition, they mentioned the ongoing projects for the year 2003, such as the further development of DocuLive (internal referral letters, chapters B and H), the scanning project, etc. Then the project leader from the IT department (ITA) showed a demo of how the electronic referral letters will look like and how it can be used. This demo meeting was supposed to be for all the health care personnel in the Neurology department. What happened was that at the same day one of the meetings for the doctors were canceled, therefore the head of the department offered to conduct this meeting instead. Even though it was planned to have this meeting later during the day, the project leader agreed to hold the meeting assuming that the doctors will inform the other occupational groups (the nurses and the secretaries). This did not happen, and the consequence of this was that the doctors received information about the electronic referral letters project, while the other occupational groups were not informed properly. The head of the department and the office director were informed in advanced about the project, and they were the ones to order new PC's for the department. However, the nurses and the secretaries in the department did not have sufficient information. This among other reasons, caused to many complexities that were faced before the sub-project even started. This was expressed by the contact person for the nurses:

> "*People don't know who is responsible for what […]. I (the nurse) just received a message saying that I have to come to this meeting, but I didn't know more than that"…*

A day after the demo meeting, another letter was been sent from the IT department to the head of the neurology department, where the project leader officially verifies choosing the neurology as pilot-department for internal referral letters. In addition, she informs that they will cooperate with the contact personnel that were chosen in advance to represent each one of the occupational groups. This, in order to elaborate a proposal to the new routines, and to decide when to start teaching sessions.

On the 13th of May, a meeting was conducted between the project leader and three contact personnel from the NEV that were chosen to represent each occupational group. As the transformation to electronic referral letters implied modifications in the existing work-practice and the division of labour, this was discussed during the meeting. There were disagreement concerning the modifications, and these were reflected in two alternatives that were proposed. The first alternative was suggested by the contact person for the nurses and the secretaries, and proposed that the doctors would write the referral letter directly in the electronic record (DocuLive). This means, keeping the existing work-practice where the doctors are the responsible for writing referral letters. However, the contact person for the doctors claimed that during the pre-visit meetings they are very short in time as they have to discuss both all the in-patients[45] and the new patients.

[45] In-patients are patients that are already admitted to the department.

Thereby, they proposed a second alternative for the modifications in the existing work-practice were the doctors would dictate the referral letters and the admission note simultaneously. Then, the secretary will transcribe them both in DocuLive, and prepare them for confirmation and signature. The discussion was tense, and both the secretary and the doctor claimed that they are already overloaded with work. The meeting ended up without being able to reach any agreement between the contact personnel.

Six days later (on the 19th), another meeting was conducted with the contact personnel in order to finally decide which alternative should be taken into use. Due to the disagreement and disability to establish any common ground between the two groups, the project leader asked them to come up with a provisional proposal that could just be for the time being, and could be changed after trying the procedure. She explained that they are the pilot departments and therefore they together, have to find the best way to implement this project. The contact person who was chosen to represent the secretaries works at the ward, so this change of having additional work (transcribing referral letters in DL) does not alter her work practice. She explained therefore that she could neither represent all the secretaries, nor take decisions for them, and I quote:

> The secretary: "*You* (the project leader) *can talk with my chief* (the office director) *and ask her to take the responsibility to decide for them"…"Or you can talk with their* (the doctors') *chief* (the head of the department)*"*...
>
> The project leader (IT department): "*Yes but still, you were chosen as the contact personnel and received mandate to decide […] and still, you are not able to reach any agreement […] I (the project leader) don't have direct contact with the head of the department*"…

The project leader from the IT department tried to explain that she already contacted their chief leaders, and that it was them who told her to contact the personnel since this change affect their work-practice and they know what is best for them. The contact persons on the other hand still insisted that they do not want to be the ones who determine the final decision, and asked again the project leader to take/transfer this discussion to the chiefs (the head of the department and the office director).

> The secretary: "*We want this decision to be part of the leader-plan"*… and the nurse: "*We want someone from the top to determine the final decision"* [46]…
>
> The project leader: "*Yes, but it is you who work with it (the referral letters), and who should know what is best for you*"…

The represents from the three occupational groups faced constrains in reaching an agreement, and the project leader was very short in time as the project was supposed to be implemented in two days. Due to this, the project leader was forced to transfer this responsibility to the head of the department and the office director. Immediately after the meeting that ended up with no results, the project leader contacted the head of the department and the office director, and asked that a final resolution will be taken rapidly. A day after, the head of the department decided to delay the project one day since the doctors had a long professor visit at the same day when they should have started using this new function. In addition, he decided that the personnel would follow the second alternative with some changes (for more details see: 5.3.4- The altered work practice).

[46] In Norwegian: "*Vi vil at det (denne avgjørelsen) skal gå på leder-plan"[…]"Vi vil at noen høyere opp skal bestemme"*

Similar discussions concerning the modifications in the existing work-practice arose also in the physiotherapy department. The project leader from the IT department discussed the adaptation process of this project in advance with the head of the department, the office director and several others from the physiotherapy department. They agreed to keep the existing work practice unchanged. This has two implications: first, it means that when the physiotherapist retrieves the electronic referral letters from DocuLive EPR, he/she will print them out and distributes them respectively on the tables that belong to the responsible group of physiotherapists (just as they used to do before). This procedure is kept unchanged due to the fact that the paper-based record is still in use and must continuously be kept updated. The second implication is that weekends-routines and emergency cases routines will not be changed yet. This means that the physiotherapists will keep using the "calling" service that they supply for the other departments, where they can be contacted by using the personal-pagers. It was agreed that changes would be conducted following partial and stepwise processes, and that these kinds of issues would be discussed later, as the project will progress.

In the meantime, the assistant doctor who represented the doctors from NEV took initiative and contacted the Physiotherapy department, in order to clear up vague issues concerning the transformation to digital referral letters. The doctor wanted to ensure that the content of the referral letters would not be changed when going to electronic form (that what they wrote so far in the paper-based forms was sufficient information). They agreed that if further information was needed by the physiotherapists, this could be retrieved from DocuLive.

On the 20th of May, the IT department planned to have a one hour teaching session to the NEV, but the personnel were under extensive stress and did not have the possibility to participate. As background information, it is important to mention that there were ten new patients that were supposed to be admitted that day (on Monday), this in addition to the shortage in nurses. Both the head nurse and her assistant were sick and therefore the nurse for education, who was their substitute, could not participate in this teaching session. The same was true for the contact persons for the doctors and the secretaries, who were under much pressure. The project leader from the IT department was forced to cancel the teaching session, assuming that there should be no problems to adopt and use the new function, since they are already familiar with DocuLive EPR. Instead of the teaching session, she offered to come to the department during the first day in order to ensure that everything was progressing well and to provide support in the field if needed. When trying to find the best time that will be suitable for the staff, the doctors explained that they write the referral letters in different points of time during the day (preferably during the pre-round), and that they were very busy due to the long professor pre-round that is conducted on Wednesdays. Therefore, the project leader decided to visit only the secretaries.

On the 21st, the neurology department started using this new function in DocuLive EPR, which provided them the possibility to send electronic referral letters to physiotherapists. The office director of the physiotherapy department was present in the beginning of the pre-round meeting in order to ensure that the project was progressing as planned, and that the new routines were adapted. A day after, the project was implemented in the physiotherapy department, which implies that from this day, they receive electronic referral letters from the Neurology department.

5. 3. 3 – The altered work practice

The work practice for the internal referral letters varies between the departments. In the neurology department, it was the head of the department who was asked to determine the modification in the work practice. He suggested that when it comes to new patients, the decision about treatment by a physiotherapist would be taken under the admission of the patient. The doctors would dictate the referral letters and the admission note simultaneously, and that the secretary would transcribe them both. In cases of in-patients, the decision concerning a treatment by a physiotherapist will be taken during the pre-round or during the ward round itself. Finally, the doctor would write and sign the referral letter electronically in DocuLive. This alternative was supposed to be adopted, but the existing work practice shows that in both cases (dealing with new patients and in-patients) the doctors write the electronic referral letters in DocuLive by themselves.

1. The decision about treatment by a physiotherapist will be taken during the pre-round or during the ward round of the patients at the NEV.
2. During the ward round meeting, the doctor who is already logged in to DocuLive, writes the referral letter, confirms and signs it. Due to the fact that there is only one computer with DocuLive in the meeting room, only one doctor can be logged in at the time. This implies that very often, the doctor who writes the referral letter is not the one who requested it. Therefore, the doctor who writes the referral letter in DocuLive, registers the name of the doctor requesting the treatment in the "*Request*" field ("*Bestilling*"). As soon as the referral letter is signed, it is sent to the physiotherapy department. The referral letter is marked with a watermark in the background indicating that it was sent.
3. Instead of going to the NEV to fetch the letters, the physiotherapists check the list in DocuLive that affords an overview over the "*untreated-internal referral letters*" ("*Ubehandlet interne henvisninger*"). Each day there is a different physiotherapist who is responsible for checking this list, once a day.
4. The physiotherapist prints the new referral letters and distributes them respectively between the six groups of physiotherapists. Just like before the transformation to electronic referral letters, the physiotherapist places the letters on the table of each group. In the morning meeting, the referral letters for each group are being distributed between the physiotherapists that are on duty. Thereafter, depending on the urgency, each physiotherapist takes the paper-based referral letters, and visits his patients in order to conduct the requested treatment.
5. After conducting the treatment, the physiotherapist writes a reply-note (which is his evaluation) using DocuLive. Then, he verifies and signs this note electronically, indicating that the treatment has been completed. This will erase the referral letter from the physiotherapist's work-list. In addition, the physiotherapist signs on the paper-based referral letter, just as he used to do before. Both the reply-note and the documentation that was written in DocuLive during the treatments' period are being printed out, attached to the referral letter and placed in the patient record.
6. The doctor at the NEV retrieves the reply-note from the physiotherapist using DocuLive.

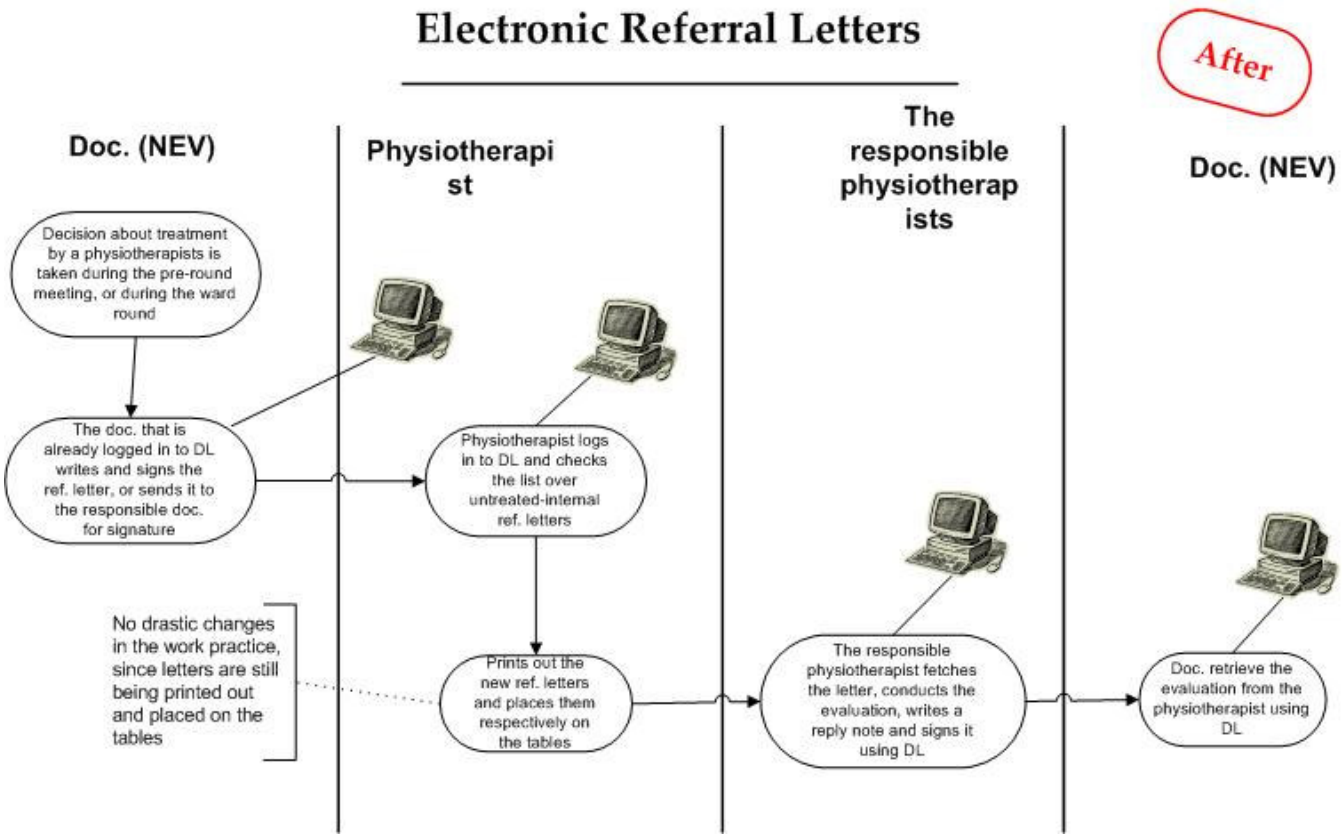


Figure 5.3.4: The work practice after the implementation of the electronic referral letters

5. 3. 4 – Implications

I would like to compare between the narrative description of the workflow before and after the implementation of the electronic referral letters, in order to single out the differences and similarities between the two. There are some links and sub-tasks in the trajectory that are clearly altered, while others are more or less the same. Basically, the core-principle of requesting an examination for a patient is left unchanged. The decision is still being taken by the physician, based on an interplay between the physician's fingertip knowledge, consultation with other physicians and the patient's medical condition. However, specific subtasks and links have been altered, as well as the participating artifacts (as illustrated in Figure 5.3.4).

A clear change that can be pointed out is that after the transformation to electronic referral letters, the health care personnel have a better and rapid access to referral letters. As soon as a referral letter is signed by the physician, it becomes visible for the physiotherapists.

Another obvious change that is illustrated in the diagram in Figure 5.3.3 and Figure 5.3.4, is that both the number of the actors and the activities diminish. When using electronic referral letters, the nurse and secretary who coordinate the articulation process of sending referral letters are no longer involved in the process, and their activities are bypassed. In other words, the doctor does not need to hand over the referral letter to the head nurse, who hands it over to the post secretary, who places it in the shelf. Consequently, a transporter does not need to pick them up and distribute them to the

clinics, and the secretaries at the clinics do not need to place the various letters in the shelves that belong to the responsible staff. Thereby, replacing paper-based with electronic referral letters will radically enhance the way information is gathered, stored, distributed, and used, as well as reducing the likelihood of losing or misplacing referral letter.

However, one can argue that when it comes to the physiotherapy department the benefit is little, as the physiotherapists come to NEV and NKI departments each day to see the patients anyhow and simultaneously fetch the referral letters. The health personnel have also the possibility to call the physiotherapists and ask them to come when they face problems. The outpatient clinics for instance, cannot provide such flexible ad-hoc service since they are under much pressure, so a cardiologist for example, cannot visit the departments. Therefore, having the possibility to send referral letters electronically to all the service departments (e.g. the medical outpatient clinic, the neurological outpatient clinic, the clinical neurophysiologic laboratory) will give a higher benefit.

In sum, bypassing the long and somehow risky chain of actors and activities, will increase the speed of the sending process, and reduce the likelihood of losing or misplacing referral letters. However, as will become evident in the analysis chapter, the introduction of electronic referral letter gives also rise to new tasks and challenges, new weak spots and dilemmas.

5. 3. 5 – Further development of the electronic referral letters

Based on the empirical description of this case, we can see that there are still issues that need to be discussed, and that there is a need for customization in the electronic version of the referral letters (it is worth to mention that redesigning the electronic referral letters and conducting modifications can be accomplished only through contacting the vendor).

This new function of the electronic referral letters (for chapters H and B2) has been tested for a period of approximately 4 month, and on the 23rd of September 2003, it was installed in all the departments in the hospital. At the current stage, the degree to which the electronic referral letters is being used and the work practice varies between the different departments. Some doctors use it massively on a daily basis while others do not use it at all, and some doctors dictate the referral letters while others write the electronic referral letters by themselves.

The IT department suggested a guide that includes a description of global routines of the workflow that the all the departments were advice to follow. This is referred to as "level one routines" (procedures), while the second level refers to the local routines of the workflow. Each department was responsible for choosing and describing those local routines depending on their existing work practice. Due to the fact that there were several departments who faced difficulties with coming to an agreement (between the various work-groups), the project leaders from the IT department took the initiative to establish several proposals for the various health care personnel.

Currently, there are many various forms for referral letters such as the ones in chapter D ("Organ function"), chapter B (B2) and chapter H (Report and notes from other health care providers). In addition, the Radiology department has a different (special) referral letter. The overall prospective goal is to integrate the various referral letters into one standardized form for referral letters that will be used by the different occupational groups.

In sum, the situation before the transformation to electronic referral letters showed us that the process of sending referral letters to the outpatient clinic was slow. This was due to the fact referral letters had to travel a long way through the organisational network of physicians, secretaries, shelves, transporters etc. Consequently, hand-written referral letters were often being lost or misplaced. The transformation to electronic referral letters was expected to eliminate this problem, as well as to enhance information handling.

5. 4 – Scanning project

In this section, I will introduce the scanning project, which is a large and complex project. As opposed to the project of the electronic referral letters, this project will have a higher impact on a large group of users, and will require strong coordination between the various healthcare personnel within the different departments. Moreover, this project will require radical changes in the existing work practices and thereby is expected to have large consequences. In this section, I will first start by providing general information about the project and the main goals, then I will introduce the scanning strategy, and the general milestones that were set up for the implementation of the project. Subsequently, I will outline some of the initial challenges that were expected to be faced, and finally, describe shortly the current state of local scanning in one of the pilot departments.

5. 4. 1 – Introduction

The scanning project implies scanning a huge amount of papers that are in the central archive, and integrating them in the electronic record. Lately, this has been a central and major issue in various discussions, and the main goal is to have all the paper-based information in an electronic form.

One of the major motivations for investing in the scanning project was the increasing lack of physical space in the central archive. When the electronic patient record (DocuLive) was implemented, there were large expectations that this would help to decrease the amount of papers that were produced in the various departments. However, this was proved to be wrong and the amount of papers increased dramatically. Since there are certain criteria saying that records that are not ten years old cannot be transferred to Riksarkivet (the National Archive), these must be kept in the hospital's central archive which is already suffering from problems with space. There are 600 records that are sent to the archive each day, and there are 60 kilo of loose documents that are sent and must be placed in the various records. Due to the large amount of work, the central archive was forced to hire 9-10 new employees. There were ongoing discussions to extend the archive's physical space by finding new places to archive all the paper records. Those discussions were dropped when a suggestion came from the IT department to invest in scanning the paper-based records. A leader from the IT department was chosen to be responsible for the implementation of the project, and establishing contact with the various actors. Thereby, the scanning project can be seen as a temporary and sub-optimal solution for handling the crises that arose in the archive department.

Another motivation for implementing the scanning project was that it had been seen as a temporary ad-hoc solution for the existing hybrid information system. At the current situation, DocuLive is incomplete, as it includes only text-based information and it does not include all the paper forms that are being used (DocuLive contains only 20-

30% of the information found in the paper-based record). In addition, referral letters and other external documents that are sent to Rikshospitalet exist in paper-based format. Due to the fact that not all paper documents exist in a digitalized format, it has been decided to implement the scanning project.

The implementation of the scanning project was expected to provide various prospective benefits. Initially, the project plans included scanning all the old paper-based records (chapter B- the passive information), incoming paper correspondence, e.g. external referral letters that are sent to the various departments, and other paper documentation that was being produced during a patient's stay in the hospital. The aim was to scan all the paper-based forms that are being used and that do not exist in DocuLive or in another electronic system. This would result in having one complete electronic record for each patient, which would include all sorts of information in a digital form. Having continues access to old notes through DocuLive, will increase the obtainability of the various sorts of information. Moreover, the transport department is expected to gain large benefits due to the fact the fewer transporters will be needed when papers will be accessible in an electronic form. Finally, since there will be no need to order paper records, the workload in the central archive will strongly diminish, and fewer personnel will be needed.

5. 4. 2 – Scanning strategy

The scanning project includes scanning a tremendously huge amount of papers. Due to the magnitude and extent of the project, various strategic decisions had to be taken, for instance, decisions concerning how to distribute the workload between the central archive and the various departments, and which vendor and technology to choose.

First and foremost, contact had been established between the IT department and three potential vendors that could deliver the appropriate technology for the scanning project. After intensive negotiations and discussions, the IT department choose a vendor that was expected to have a strategy that could be customized to Rikshospitalet's infrastructure. On the 20th of June 2003, the vendor was supposed to deliver the product, including the suitable technological devices (i.e. small and large scanners), and the software that were needed. It was agreed that the vendor would deliver the product followed by formal proposal letter to Rikshospitalet, and that Rikshospitalet would confirm the proposal. Conflict aroused when the vendor followed only parts of the agreement. There was a tense period with extensive discussions between the vendor and the project leader from the ITA, the project was delayed, and this bottleneck was more complex than anticipated. In the end, some kind of agreement was reached, and the implementation of the project continued.

Thereafter, there were various discussions concerning finding a suitable and effective scanning strategy. Finally, it was decided that the various departments and the archive would focus on scanning paper records that belonged to active-patients, including both existing and new patients. However, old paper records that already existed in the archive would not be scanned as for now. This includes records that contain old information or belong to patients that passed away. There were several exceptional cases, like for instance patients who have chronic diseases or patient who had transplantation, since

these patients will come back to the hospital for control. In these cases, the historical medical background is paramount even though it is old information[47].

Due to the large amount of papers that needs to be scanned, the division of labour must be distributed between the various departments and the central archive. In other words, there will be both central and de-centralized scanning.
When it comes to the central scanning, the archive would be responsible It was decided that each paper record that were scanned, would be registered in a list which would give a complete overview of the scanned records. After scanning each record, it must be downloaded manually to DocuLive so it can be visible in the EPR. When this is done, the paper record should be shred. There must be clear and specific guidelines for this procedure in order to avoid having hybrid records and redundant scanning. It was decided to begin with the centralized scanning, and then go over to local scanning. The test phase of the centralized scanning was planned to take place in the archive department. During this test phase, the central archive would try to estimate the resources that they needed for the scanning and shredding procedures, both in terms of time used and manpower that is needed. In addition, they would try to explore and establish optimal procedures for scanning. But due to the delay, this test phase could not be run prior to the start of the de-centralized scanning.

The implementation of the de-centralized scanning would be distributed among the various departments. It was decided that each department would have the responsibility to scan the following documents: external referral letters that are sent to the departments, other incoming mail, internal documents that the department produce during the patient's stay, and finally, the rest records (chapter B- the passive, i.e. old information). The Cardiology department for instance can scan the ECG's since they are the ones to produce and use them, and the anesthesia department can scan the F2.03 form ("Message to operation- anaesthesia") since they are the ones who use them. De-centralized scanning implies that the responsibility is distributed among many actors from various departments, and therefore, strong coordination must be adopted between the archive and the departments. In addition, it was paramount to have a clear, detailed and descriptive plan for the overall implementation process. This had to be a well-planned and controlled process due to the reason that documents that were scanned should not be available again in paper-form. One should continuously keep a track of what was scanned and ensure that those will be shred, or stamped with a "*scanned"* label. Moreover, the information to be scanned had to be defined clearly. According to the current work practice, the various departments send every piece of paper to the archive, including drafts, yellow notice-labels and so forth. Thereby, a hospital-wide resolution concerning which information was categorized as relevant to the patient record was developed and implemented. Four pilot departments were chosen in order to start the de-centralized scanning. This includes: the Medical department (two units: the lipid-clinic and endocrinology), the Medical Out-Patient Clinic, the Woman's Clinic, and the Neurosurgery department. Subsequently, technical devices were provided to each department, as well as scanning courses to the secretaries (as they are the ones who will be responsible for this procedure).

[47] It is worth to mention that this empirical information was collected during September 2003, which implies that there might have been changes in the various decisions

5. 4. 3 – Expected challenges and initial experience

This project introduces many challenges and constrains of various arts. One of the obvious challenges that were expected to arise, concerns the multiple quality and types of documents that are being used and stored in the paper-based record.
This had been expected to be highly challenging, as some of the paper forms and the graphical pictures have very poor quality. Moreover, some of the paper forms have various sizes; some are regular A4 format/size while others are A3, A5 or huge posters. The anaesthesia department for instance, uses forms that constitute of multiple sizes. Thereby, not everything would be scanned; it was decided to prioritise scanning only the paper and posters that are being used. The central archive will be responsible for scanning these documents that does not have a regular A4 size since they will be provided with various types of scanners. But when it comes to the anaesthesia department for instance, it has been suggested to provide the department an A3 scanner since they produce A3 paper forms that are being used both for pre-operative and post-operative procedures. Other challenges concerned determining the format of the scanned documents, as it was paramount to find a way to manage long-term storage. In this end, it was decided that the scanned documents, would be saved in TIF format as pictures. Risk-evaluation and safety routines had to be resolved. The overall aim was to have all the patient record in an electronic format and to shred all the paper records. However, since the only source that will be available is the electronic-based information, this implies that having a stable and secure system for the electronic record is paramount. Functions as updating the database and such, must not affect the electronic patient record (as it is in the current situation). The IT department decided that the departments would scan papers, mark them as "*scanned*" documents, and store them in boxes each day. The boxes will be marked with dates and will gradually be sent to the central archive. This practice was established due to legal reasons. Shredding the paper records is not allowed until the electronic systems are approved by national archiving authorities (Riksarkivaren).

Scanning the various records of the existing active patients in the entire hospital will take time, and in the meanwhile, there will be a transition period where both paper-based and electronic records will be used simultaneously. Due to this hybrid and redundant practice, it will be important to make it visible which records have been scanned.
When the decentralized scanning started in the pilot departments in November 2003, several start-up problems and complexities were faced[48]. Some were technical problems with the software (e.g. error messages that occurred when a new electronic record was created), while others were problems with the scanners, e.g. that sometimes they did not accept more than one document at the time. Other complexities that occurred concerned questions of what information should be scanned (e.g. should an empty backside of a form be scanned?). Information could be written with a pencil, or words and sentences could be highlighted (using a marker pen) on the forms, or colored stamps could have been used. The paper documents were of various sizes, different thicknesses and diverse colors, some of the documents had been folded etc. This led the need to often reconfigure the scanner's settings.

[48] This information is not based on my own fieldwork, but is briefly referred here for reasons of completeness of the overview of the scanning project. The empirical material was collected by my colleague researcher and supervisor, Margunn Aanestad, during a period of approximately three months (from the beginning of December 2003, until the end of February 2004) at the Woman's Clinic.

Another challenging issue concerned the point of time in which the different documents should be scanned. For instance, should the secretaries scan a laboratory-test result before or after the physician signed the form? Beside the issue of *when* to scan the documents, the issue of *where* to place the documents in the EPR arose. Like for example, it must be determined in which chapter to place documents such as the questionnaires that are given to the patients. Most such questions got resolved when the project was actually underway. What remains as the larger challenge, is the necessary transforming of work processes that has been established around the paper documents.

6. Analysis

Understanding the infrastructure as a "whole" and the interpretation of its "parts", will guide this analysis. I will start by analysing the fledging infrastructure of the EPR as a "whole", and will subsequently go to "parts" of the infrastructure by analysing the referral letters case and scanning project. In this chapter, I will use the information infrastructure perspective along with concepts from the CSCW field. Through the lens of holding together these bodies of theories, I will analyse my empirical cases. By following an infrastructural focus, I will emphasise the important of acknowledging the installed base, and the need for integrating the new system with the existing components. I will hold this focus together with a work practice orientation and *use* focus, and underscore the important of acknowledging these. In addition, I will illustrate how work practices and interdependencies can be seen as installed base, which are complex and difficult to change. Accordingly, I will underscore the need for finding ways to manage a gradual transition

6. 1 – Understanding Infrastructure Development and Growth

By holding together these two theoretical perspectives, I analyse the development and implementation process of the EPR in two departments. In addition to using the information infrastructure perspective and emphasising the importance of the installed base, my aim in this section is to underscore the important of acknowledging situated work practice. I try to illustrate how work practices and interdependencies can be viewed as installed base which are complex and difficult to change. Hence, acknowledging these is paramount within the gradual transition process of changing the infrastructure.

6. 1. 1 – The EPR as a fledgling infrastructure

My theoretical perspective is to view Electronic Patient Records (EPRs) through the lens of information infrastructure perspective. This implies that EPRs are not being seen as individual tools, but rather as elements in a large and complex infrastructure. As an attempt to comprehend the complexity of EPRs, I follow in addition a socio-technical approach along with reflections from the actor network theory. Using these perspectives, I look at the hospital as a large and complex actor-network, with a strong organisational structure, including existing technologies, software vendors, users and so forth.

The infrastructure of the electronic record was not developed from scratch, but rather based upon the existing installed base. The electronic record was heavily influenced and shaped by the paper-based record that was improved and standardized prior to the implementation of the electronic record.

The infrastructure of the medical record is open and scaled. It is shared by many heterogeneous healthcare professionals who have various and sometimes contradicting needs. It contains information that is used in diverse areas for different purposes. Physicians, for instance, use the EPR for diagnostic and therapeutic decisions. Others users of the EPR are public authorities from national and county level, or the hospital's

management, who use extracted data for statistics and planning. In other cases, the medical record is used for generating research information; it may be used by insurance companies, and so forth. Hence, the medical record is more than just a documentation tool. In addition to guiding and supporting physicians with decision-making, it is also a cooperation tool and a management-oriented tool for administrative use. Here we can see that the medical record is open and used for multiple use-areas and activities that evolve over the time.

When looking at the electronic record in an information infrastructure perspective, we can describe it as a common resource in the actor-networks. Various standards had been adopted in order to make the medical record a common resource that supports communication in a heterogeneous actor-network. The infrastructure of the patient record is built upon both technical and social standards. For instance, the different forms that are being used by various healthcare personnel allow flexibility in the local departments. Even though the medical record accumulates many different forms that are being interpreted in various ways depending on the context, all the actors have a common understanding of the documents in the record. This common understanding is a central standard in the infrastructure of the record. The various routines and situated work practice can also be seen as standards in the sense that there are many actors who follow them and it contributes to institutionalisation. Another example is the ICD book[49] (International Classification of Diseases), which is the classification and coding system for diagnoses used in the hospital. It is embedded into local practices, and the meaning of the codes depends on these local practices. Standardizing allows the establishment of a large and complex actor-network, having a general assumption that all the actors follow the standard.

The infrastructure of the EPR is a socio-technical network consisting of both technical and non-technical components. It interlinks heterogeneous network of actors, knowledge, procedures and routines around them. Hence, neither the paper-based record, nor the EPR can be seen as isolated components. The infrastructure of the EPR is built upon the paper-record, and it is integrated to some degree with other infrastructures in the network. In other words, the infrastructure the medical record is built upon ecology of networks, and it should be viewed as a shared irreducible unit which includes heterogeneous and tightly interconnected components.

Summing up the infrastructure aspects we see that there is a growing need for flexible record systems that are able to support highly complex work practice. Thereby, in the next section I will describe the implications for change, and the crucial role of the installed base in relation to that.

6. 1. 2 – The importance of the installed base

Viewing the EPR as an information infrastructure implies that it is developed through extensions and improvements of the installed base. A description of the installed base that existed prior to the EPR, was provided in the historical reconstruction, in chapter three. My aim was to provide an overall view of the complex evolution process of the infrastructure. This process constitutes several necessary changes in the highly fragmented infrastructure that existed. The first change was standardizing the clinical information in the paper record, by merging the various forms that existed. This allowed merging all the local archives, and establishing a centralized one. All these improvements

[49] International Classification of Diseases (ICD) is worked out by the World Health Organisation (WHO).

decreased the fragmentation of the paper record. Subsequently, the technical infrastructure was standardized by diffusing the first PCs and installing a LAN in the hospital. Thereafter, the EPR was built upon the infrastructure of the paper record, which implies that it was built upon components that were improved and gradually became interdependent. Hence the existing infrastructure of the EPR carries the heritage from the past (the installed base), to the present and further development (to SOARIAN or CSAM).

Describing the various existing information systems, in the middle of chapter three (section 3.2), increase the importance to consider the installed base. The descriptions of the current status, describes how the EPR meets the local infrastructure which is fragmented and consist of various local information systems. Having such a complex and heterogeneous network as the infrastructure in the hospital has two implications. The first one is that introducing new components, or re-designing existing components, often has consequences for the entire network. The second implication is that having such a complex network implies that it can be profoundly difficult to see the implications of the changes. For instance, when the local archives were merged and the EPR was implemented, this had consequences for the other components in the network, however the implications of these changes were not easily visible on the surface of the overall infrastructure (these were somehow behind-the-scenes). The re-emergent of local sections within the record, were revealed after the implementation of the EPR. When work practices concerning printing routines were discussed, the backstage parts or the underlying layers of the paper-based infrastructure were deconstructed. The degree of the complexity of the organisation and the infrastructure became clear to me when I shared parts of my empirical data with one of the staff from the IT department. After exchanging with him my impression of the existing situation, he told me that he was surprised to see that the situation was so different from the expectations. Even though he was familiar with most of the bottlenecks, he did not know to what extent these had an impact on the work practices.

The current fragmented and evolving information infrastructure that consist of several partly overlapping, complementary and interdependent information systems, accumulates the pressure for integration. Due to the growing complexity of the infrastructure, it is paramount to find transition strategies for scaling and evolving information infrastructure. However, scaling the infrastructure of the EPR is not trivial, as the need for integration has to be negotiated and balanced against the conservative influence of the existing installed base. This refers to the organisational, economical, and technical investments. For instance, the existence of the various specialized (and stand-alone) systems that still exist in the different departments, illustrates among others, how difficult (and maybe undesired) it was to remove them. Another related issue that can be discussed is how to integrate the various information systems. The issue of integration's mechanism is analysed by Monteiro (2003), who explains how on the one hand, integration can be implemented by following a centralized solution which will provide little autonomy for the other components. While on the other hand, a decentralized approach can be followed, encouraging robust and independent components (Monteiro, 2003). This is an interesting issue, but due to the scope of this thesis, I choose not to go further into details. Instead, I choose to propose a strategy for dealing with different practices and/or different information technologies (technological solutions). One way is to apply gateways that can link the various incompatible components (systems).

Gateways can be seen as 'translation devices' that allow parallel coexistence of networks, and avoid breakdown in the chain of work.

As previously mentioned, in order to understand how the EPR affects the medical work practice, it is important to study the installed base that the information infrastructure is built upon. However, it is also paramount to study the changes in the social ordering that are caused by information technology. By this I refer to the organisation of the situated work practice, and the use of artefacts in the medical work. The fact these are linked to each other in the socio-technical network, and that there are mutual interdependencies of technologies and work practices, implies also that the existing structure will effect and may constrain the new one. Hence, changing the paper record to an electronic record implies that the properties of the electronic record do not fit into the links of the paper-based record (i.e. binders, shelves etc). However, there were high implementations' costs that had been invested in the infrastructure of the paper-based record. Karl Dahl (1998) provides in his thesis an analysis of these implementations' costs, describing the various artefacts that support the medical practice, and the technologies that were designed to give paper-based print-outs (e.g. ECG machines). Furthermore, he explains how an archive had been established and adapted to this structure, and copy-machines and fax-machines had been bought to provide re-production of information. Finally, the work practice had also been accommodated to the need that the actors have when using a paper-based infrastructure. Dahl explains that throwing away all these investments can be very difficult and complex (Dahl, 1998).

6. 1. 3 – Inscriptions in the infrastructure of the EPR

To which extent it is possible to reduce the distance between technology and work practice depends on how strong the inscriptions are that the actors have. The concept inscription refers to the way artefacts embody pattern of use. The paper record has a very flexible infrastructure, and it is able to support various work practices and contingent routines. Yet, restrictions of the flexibility for how to use the record can be desirable for several actors. Implementing restrictions allow ensuring the quality of the treatment process. For instance, when dividing the medical record into ten chapters, the health personnel are restricted in the flexibility of use. This was implemented in order to ensure that all the medical information that is relevant for diagnose and the treatment is being registered accurately. This became to be more relevant as the medical record is gradually playing a more important role in malpractice claims. When documents are not stored in the correct chapter, the purpose of this organisation is violated and lost. But the infrastructure that the paper-record uses is flexible enough to handle this problem. In such cases, the secretaries or the archive personnel perform additional tasks with straightening up the records. As this is not always practiced, the structure of the paper-records became loose and the volume increased gradually. As opposed to the paper-based record, this problem is not faced when using an EPR, as it embodies inscriptions. When a note is being transcribed into the EPR, it is being automatically stored in the corresponding chapter. In other words, the infrastructure of the EPR accumulates inscriptions that pose restrictions on the work practices, and does not allow the flexibility that is obtained when using the paper-based records.

The EPR had been designed in such a way that it inscribes desired program of actions. When comparing the infrastructure of the paper-based record, the infrastructure of the

EPR restricts to a larger extent the flexibility of use. For instance, when a note is being written in the EPR, it must be signed by the physician. Otherwise, the note will continue to appear in the physicians' work-list (in the EPR). I have been told that before the implementation of the EPR, the physicians did not have to sign so many notes. This means, that signature-routines were not always practiced when the paper-based record was used. However, after the transformation to an EPR this had been changed, due to the fact that the infrastructure of the EPR enforces the physicians to sign on their notes. As the flexibility that was obtained when using paper-records was not allowed anymore, there were several physicians who had long lists of unsigned documents.

Another example of inscriptions that can be found in the infrastructure of the EPR concerns the signing policy of epicrises that are sent to external organisations. According to this policy, an assistant doctor must always have a contra-signature from a head doctor. The EPR accumulate inscriptions that forced the users to follow this policy.

The EPR, DocuLive, contains several templates for documents. The one for nursing notes is based on the VIPS standard. As opposed to the free-text approach, the VIPS standard has a strong context and problem oriented approach, and its structured-content makes information easily analysable and reusable. Since the standard differs slightly from the ones that were used by the various occupational groups, the existing work practice for writing notes had to be changed. Hence, when the health personnel write a note into DocuLive, they receive a pre-defined layout that force them to write the note in a structured way covering specific issues and following a pre-defined chronology. In other words, the EPR inscribes the work practice for writing notes.

So far, I described the inscriptions that can be identified in the infrastructure of the EPR, and in the next section, I will apply the adaptations in the evolving infrastructure. In addition, I will try to illustrate how the transition process to an EPR is a mutual, dynamic, and reflexive transformation process of both information infrastructure and situated practices of use.

6. 1. 4 – The EPR in *use*

Over the time, the infrastructure of the EPR has been constantly evolving as the environment changes. The number of users increased gradually, and they learned more about the technology as they discovered new ways to use it. Customisations in the technology were conducted, in order to adapt to these new use areas. In other words, the infrastructure of the EPR had to evolve and adapt itself to the learning and environmental changes. In order to acquire a better understanding of the infrastructure development and growth, I refer to Gasser (1986) who suggested three processes to integrate computer systems with work practice. Examples will be given to illustrate these processes which include adaptation, extensions and evasion of the system.

The *adaptation* is a mutual process implying customisation of the technology and the existing context dependent work practice, in order to decrease the distance between the two. An example that illustrates how the health personnel had to align their existing work practice to the new technology is the previously mentioned templates for writing notes. After the transformation to DocuLive, the various occupational groups had to adapt their work practices for writing notes to the new templates. This implies that both the secretaries who transcribe physicians' notes and the nurses, had to follow the new templates. Moreover, it also implies that the physicians' dictating routines had to be aligned to the new templates, meaning the physicians had to change the issues covered

and the chronological order of the dictation. Gradually, the various departments were given the possibility to customise and adapt the templates so that they will accommodate their heterogeneous needs. Another example that illustrates adaptations that had to be done in the technology, refers to the changes in the signing policy for external epicrises. In order to accommodate to complex and situated work practice that was identified in the neurosurgery department, all the doctors were given the possibility to sign each other's notes. This ad-hoc solution was an exception that was conducted due to the fact that the neurosurgery department deals very often with emergency cases where the time aspect is incredibly crucial.

In the beginning of the implementation process of the EPR, the work practices remained unchanged. The secretaries were still responsible for transcribing the physicians' notes. They did not change their work practice, and kept printing out the electronic notes and placing them on the physicians' shelves. Then the physicians used to mark the corrections on the paper-based note and hand it back to the secretaries, who apply the changes and update the electronic version. Printing the electronic notes is an illustration of the 'work-arounds', also referred to as 'gateway practices', that had been developed by the physicians in order to preserve the existing work practice where the secretaries are responsible for applying the correction of the transcribed note. However, as the system became embedded in the work practice, local adaptations developed. Gradually, physicians adapted their work practice to the electronic record, and started correcting their notes by themselves.

The EPR was not merely used for signing and writing notes, but also for retrieving information. Observed phenomenon shows that during the pre-ward meetings, physicians used the EPR to retrieved updated information. Paper-based information sources where used only when the information did not exist electronically, like for instance, the forms that are in the curve-book.

The infrastructure of the EPR, had to gradually evolve and scale in order to meet the new requirements. This had been done trough the previously mentioned *extensions* and improvements of the EPR (see chapter 3.3: The transition strategy at RH). Incremental improvements were conducted in DocuLive, and new versions were implemented and installed. For instance, DocuLive EPR was first extended to include the protected-record (used by special departments like psychiatry), and then, integrated the birth-record (Obstetrix). Thereafter, the evolving infrastructure of the EPR was extended to include electronic internal referral letter, and is planned to integrate electronic request and reply of laboratory test-results.

However, *evasion* of some features in the EPR system was also identified. Many physicians avoid using existing feature as the electronic prescriptions and work-off orders, by continuing using the paper-based forms instead.

6. 1. 5 – Changing articulation work and trajectories

When abstract design principles meet the situated work practice, this has an impact on the workflow and work process. In this section, I will try to summarize the impact that DocuLive had on work practices, and on the interdependencies of work.

DocuLive obtain new properties that have an impact on the work practices in various ways. Using electronic patient record increase the availability of the patient record. The

record can be access for different purposes from the various departments simultaneously. This accessibility and obtainability of the medical record was an important benefit since the health personnel spent less time in ordering records from the archive or searching for records that were not found. These benefits had a positive impact of the users' attitude towards DocuLive, and encouraged to some degree more user-involvement. In addition, better organisation and structured standardized presentation was acquired to the electronic record. Yet, according to the empirical material, nurses used longer time in front of the computer. The paper-based records and the electronic record are being used simultaneously. This fragmentation in the medical record system requires the health care personnel to cope with and manage two technologies simultaneously. Accordingly, the health care providers print out all the electronic notes, secretaries spends much time straightening up the paper records, and archive personnel spend an extensive amount of time trying to store the many loose papers that are being sent to the archive separately from the record. After the transformation to electronic patient record, the improvements in work were insignificant. Although notes in the electronic patient record were produced in a different way, the traditional sequence of activities remained unchanged. However, the distribution and division of labour is altered, and the performance of most of the activities is changed.

The implementation of DocuLive, had an impact on the interdependencies of work. The physicians' responsibility to keep the trajectory work moving has increased. After the transformation, the physicians were only partly dependent on the secretaries to locate or order paper-based records from the archive, this refers to cases of patients' records that were created before the implementation of DocuLive. In addition, in principle, physicians were not dependent on secretaries to transcribe notes as they have the possibility to do it on their own. In general, we can say that the physicians are less dependent on administrative staff in work.

The transformation to an EPR was not revolutionary, but rather accumulated subtle and increment displacements, and changes within simple information handling and actions (on activity-level) were identified. Gradually, the number of users of the EPR increased, and an installed base of EPR users had been developed. However, the existing infrastructure of the patient record is hybrid, and both paper-based records and the electronic records exist side by side. DocuLive is not complete, as it lacks integration with other technologies that are in use. Moreover, there is a need for a better process- and workflow- support. At the current stage, DocuLive lacks features that can support and enhance coordination of work. In order to show the importance of these issues, in the next section I will analyse the in-depth case study of the Parkinson patient's trajectory.

6. 2 – Parkinsons Case- Work Practices as Installed Base

While I was following the implementation process of DocuLive, my initial aim was to understand the impact that the EPR had on the medical practice, and to uncover the complexities that were faced in two departments. When looking closer at the complexities, I noticed that beside the ones that were faced with the technical infrastructure, there were several complexities that were related to the situated work practices. In addition, I noticed that after the transformation to DocuLive, the achievements in work were insignificant. Accordingly, I felt the need to learn more about

work-oriented practices, by exploring coordination work as well as artefacts embedded in the medical practice.

The Parkinsons case is an in-depth case study that illustrates the elements of the socio-technical infrastructure, which cross disciplines, information systems, and work practices. Here, I choose to view situated work practices as installed base, in order to illustrate how complex work practices can be, and emphasise the importance of acknowledging these within the transition process of changing the infrastructure.

6. 2. 1 – Understanding work practices

The Parkinsons case illustrates a long and tremendously complex process. The length of the case is illustrated by mapping the pre-operative and post-operative procedures, as well as central patient care process. The Parkinsons case can be divided into five main critical phases, where it is being decided whether the patient will be operated or not. The first phase includes undergoing many diagnostic tests (examinations and procedures) in order to elucidate the case, and it takes place in the Neurology department (identified as process nr. 9, in the first diagram, figure 5.2.1). The second phase is when the neurologists decide whether to send a request to the NKI in order to operate the patient. Subsequently, the third critical phase is, the interdepartmental meeting that is being conducted between the neurologists and the surgeons, where it is decided whether the patient will be accepted for operation (identified as process nr. 12). The fourth phase takes place at the Neurosurgery department where the patient is undergoing an operation (identified as process nr. 14). Finally, the last critical phase concerns the periodic controls that the patient has to undergo during the rest of his life (identified as process nr. 17).

Levels of decision-making:

The earliest symptoms of the Parkinsons Disease (PD) may be non-specific, and it might be difficult to clearly identify and diagnose the disease for some time.
Various clinical examinations are being conducted in order to sort out other diseases that have similar symptoms to PD. Like for instance, United Parkinsons Disease Rating Scale (UPDRS), the Cerebral Blood Flow examination, testing physical movements, MR, CT and so forth. Moreover, the trajectory accumulates several levels of decision-making. In our case, I identified three levels, where the first one is based on the paper-based external referral letter that is sent from Sørlandet hospital in Kristiansand. The second level accumulates the examinations at the neurology department, where the patient undergoes various diagnostic tests in order to elucidate the case. The pre-operative examinations are being ordered in advance based on the epicrise from Sørlandet hospital in Kristiansand, while the additional examinations that are ordered during the admission of the patient are based on the personal meeting with the patient. Finally, the last level of decision-making refers to the Parkinsons meeting, which is an interdepartmental meeting between the neurologists and the surgeons.

The articulation of a trajectory that cross disciplines:

The Parkinsons case shows how managing a trajectory involves carrying out several lines of work, where each one is constituted of task clusters. Due to this and other reasons, each health care personnel have knowledge only about the task clusters that he is responsible for, and which are related to his department. This became clear to me when I collected empirical information for the Parkinsons case, as I often faced situations were the health care personnel provided me imprecise information that was based on

assumptions. For example, due to the fact that the Parkinsons meetings involve only two surgeons from the neurosurgery and three head doctors from the neurology, other assistant doctors did have precise knowledge about these meetings. In the Parkinsons case, the twelve prospective steps that are being introduced in the first diagram are examples of task clusters. Each step as such, accumulates several more clusters of tasks. An illustration of that can be found in the second and third diagrams (see figures 5.2.2 and 5.2.3) where I zoom into three processes.

The articulation of a trajectory varies between the departments and the occupational groups. For instance, ordering examinations is done in various ways using different communication channels depending on the work practice in the divers clinics. Blood test examinations and ECG's are ordered by the pipe-post, yet other examinations are ordered by the telephone, the internal post or fax.

The Parkinsons case involves several health care organisations. In our case, this includes Mr. Smith's primary doctor in Mandal, the neurology department at Sørlandet hospital in Kristiansand, and Rikshospitalet. Moreover, a complex trajectory as such, includes many interdisciplinary actors from several clinical and service departments. Within Rikshospitalet the trajectory of the Parkinsons case involved mainly the neurology and the neurosurgery department, but it also involved several other service departments as for instance the radiology department, the outpatient clinic, the neurophysiologic laboratory etc. Each department has various occupational groups, which conducts heterogeneous work practices. For instance, we see from the description of the pre-round meetings that physicians are responsible for making decisions, nurses carry out requisite operational tasks, and the head nurse is responsible for the articulation work itself.

Unexpected contingencies:

An illness trajectory, as the one described in the Parkinsons case, demands comprehensive organisation of work around the patient. The articulation of the medical work is highly complex and evolving, and various unexpected contingencies may arise. The patient trajectory involves several services, and the likelihood that the schedules will go awry is high and demands ad hoc rearticulation of work and oral-communication. In order to keep the narrative description clear, I choose to simplify the case by excluding potential disturbances and problems that might have occurred. Like for instance long waiting lists for diagnostic examinations that might delay a treatment, long waiting lists for the operation, emergency situations or complexities with technical devices (e.g. a machine breakdown). Such disruptive conditions may suddenly occur and change totally schedules of trajectories. Postponing Parkinsons operation is not an easy task as the operation demands the presence of two Parkinsons surgeons, and it is a long operation that takes a whole day (8 hours). Therefore, very often when such an operation is postponed, it is for a week or two. Another example of disruptive conditions is the long waiting lists for the MR examinations at the Radiology department in Rikshospitalet (illustrated in figure 5.2.1, step 9.b.iii.). I have been told that such examinations are often delayed for two or three days. I even observed a case were a patient had to wait five days for an MR appointment, and due to this, the head doctor decided to send the patient to an external private imaging institute. Such long waiting lists can be identified as bottlenecks and they cause delays and breakdowns in the workflow. Disruptive conditions such as the long waiting lists for the examinations and the Parkinsons operation, can be identified as bottlenecks in the workflow. I would like to identify the implications of having long

waiting list for the operation. After being accepted for an operation at Rikshospitalet and before attending the operation, the patients must be registered on a waiting list. However, being on a waiting list has two drawbacks, were the first one refers to the evolving character of the illness. As the time goes by, the illness changes; this implies that the patient will have to be examined again and a new evaluation of the operation will have to be conducted. The other drawback is especially relevant to older patients who had been waiting for such a long time that an operation would not give them any clear benefits. During the last year, there was only one case where the surgeons at the NKI had to conduct a new evaluation for the patient, and two other cases where they did not have enough capacity to perform the operations.

Beside the unexpected contingencies that are described above, the development of the patient's condition, physical and psychological response to the treatment cannot be fully predicted. It is difficult to predict patient's reaction to a treatment, how an operation would go, or how the patient's medical condition will evolve. A Parkinsons operation can prove to be unpredictable and cause to post-surgical infection or other complications. Thereby, as illustrated in the case, there are several levels of decision-making, and various critical levels accumulated in the trajectory. It is also worth to mention that Parkinsons disease usually occurs at an older age. This implies that, very often, Parkinsons patients suffer from additional diseases. In sum, the Parkinsons case study shows that patient's trajectories cannot be foreseen, and that these (trajectories) vary a lot depending on many aspects.

Collaboration and interdepartmental dependencies:

The case study shows us also how the articulation of a trajectory is highly collaborative in terms of coordination and reaching common understanding both within and between the occupational groups. In addition, the case illustrates the complexity of division of labour, and how the multiple trajectories can be both parallel and sequential. Some of the trajectories are performed in parallel to other process, i.e. simultaneously. For instance, consider a situation where after meeting the patient the assistant doctor decides to order additional examinations (i.e. MR and blood tests). The patient coordinator will be responsible for sending the requisition for MR examination, parallel to the post secretaries who will be responsible for sending requisition for blood test examination. Beside trajectories that are performed parallel, there are many (trajectories) that must be performed in a specific order. For example, the assistant doctor must have the results from all the pre-operative diagnostic tests in order to be able to summarize his findings in the morning meeting with the doctors. Consequently, the head doctor cannot perform the UPDRS before receiving a summary of the patient's medical condition from the assistant doctor. Another example is the anaesthesia preparation that must be performed before the operation. The case accumulates many collaborative and interdependent trajectories, however I chose to outline just a few examples in order to illustrate how collaboration is vital and necessary in such a complex case.

The fact that trajectories are highly collaborative and interdependent implies that a breakdown or a bottleneck will demand ad hoc rearticulation of work, as might cause to delay the whole trajectory. I would like to take a step further and describe the prospective breakdowns and bottleneck that I identified in the case study, that might slow (cause to delay in) the information flow and the workflow.

The first examples of a prospective bottleneck that is identified is when an external health care organisation sends a referral letter directly to the Neurosurgery department (instead of sending it to Neurology), in order to ask for a second opinion and request a proposal for other prospective treatments. In these cases, the surgeons at the Neurosurgery department (NKI) act in two ways. Either they send the patient directly to the Neurology department (NEV) for diagnostic tests (examinations and procedures), or they invite the patient to the outpatient clinic for consultation. During this meeting, the patient is informed about the risk that is implied in conducting such an operation, and the patient's motivation for an operation is evaluated. The responsible surgeon then writes a summary note from the following conversation emphasising the important issues of the case, and at the same time he writes a referral letter to the Neurology department (NEV). In this referral letter, the surgeon requests the neurologist (that are responsible for Parkinsons cases) to admit the patient to the NEV department and to conduct diagnostic tests (examinations) following a special regime. These examinations will allow decision-making concerning either an operation, or adjustments in the medicines (whether to increase or decrease the dose). The diagnostic examinations are conducted at the NEV at Rikshospitalet, even though the patient has already gone through this process in the other hospitals. This is due to several reasons, however, the main reason is that Parkinson is a disease that develops and evolves over time. This implies for example that a CT that was taken two years ago, might be too old and out of date. Another reason is that each hospital has different routines for conducting diagnostic tests (examinations). In addition, it is paramount for the NEV and the NKI department at Rikshospitalet to be completely sure about their final decisions. In summary, we see that patients might be sent to other departments before they reach the Neurology department, and this may cause a delay in the process of starting the medical treatment.

A small breakdown in the information flow can be identified in point 12.e. (illustrated in figure 5.2.1). After the meeting between the surgeons and neurologists, it is decided whether the patient will be operated upon or not. The documents including the final decision are sent to the application office, which sends them further to the patient coordinators at the NKI. At this point, it is only the patient coordinators at the NKI who receive the list of the patients that will be operated upon. The patient coordinator at the NEV is not always informed about the final decision (meaning which patients be operated upon), and therefore asks the secretaries that transcribe epicrises to inform her about the patient that will be operated. However, it is worth to mention that while conducting the fieldwork, I received signals that this situation was about to change as the patient coordinator at the neurology department received a program (Albert) which gave access to both patient coordinators at the NEV and NKI. This program contained information about planed operations.

Another breakdown can be identified when the doctors at the NEV decide when the patient should come for periodic control. Previously, it was the surgeons at the NKI department who called in patients for periodic control. After establishing a better collaboration between the NEV and the NKI department, this responsibility was transferred to the doctors at the NEV department. However, due to breakdown in the information flow, the patient coordinator in the neurology department is not always informed about the final decisions of the doctors. Consequently, when patients call the patient coordinator to ask about their appointment for control, she does not always have updated information, even though it is her responsibility to register patients for a day-treatment and to ensure that there is a doctor that can see the patient. Again, it is worth to

mention that after providing the patient coordinator at the NEV department access to the operation-planning program (that was previously mentioned), this situation was about to change.

A breakdown in the workflow can be identified when the patient is transferred from the NKI to the NEV department (identified as step nr. 15 in the first diagram, figure 5.2.1). After an operation, the patient is transferred to the NEV department for recovery and control. This can be problematic as the staff from the NEV department often claimed to suffer from shortage in place. A transfer of a patient to the NEV department can be planned only to some extent due to the fact that complexities may arise during the operation, and it is difficult to decide in advance when the patient will be transferred to the NEV. Therefore, by following the "list-patients"[50] in PiMS, the staff at the NEV department can find out when are the patients supposed to be transferred. Still, based on my observations and the shadowing session, I noticed that the nurses at the NKI department faced constrains when they wanted to transfer a patient to the NEV department. This bottleneck in the workflow is solved by transferring the responsibility to the head nurses on both departments. Hence, when a patient is supposed to be transferred to the NEV department, the head nurse at NKI usually contacts directly the head nurse at the NEV and coordinates with her the transfer procedure.

The case study of work practices, illustrates how the medical practice is highly complex, dynamic, distributed, and regulated. Moreover, the case illustrates the interdependencies between the various elements, actors and departments. These interdependencies implies that changes must be conducted in a coordinated form in order to prevent disruptions and avoid breakdown in the whole chain of work (workflow) due to one department's adaptation of new work practice. This can be related to adaptation of a new information system as the EPR, or a new feature in the system i.e. electronic referral letters.

6. 2. 2 – Artefacts that are central in managing patient's trajectory

Exploring the use of artefacts is one way to study the impact of the EPR on the situated work practice and on interdependencies in work. Drawing upon the Parkinsons case, I will outline several examples of artefacts that have crucial roles as supporting work- and information-flow, and coordinating activities.

Artefacts' roles:

Along the description of the case study, we can find various examples of artefacts that are embedded in the work, and have central roles in organisational management. The patient record, the forms that it accumulates, the various lists, progress notes, and whiteboards, are central in managing and mapping the patient's trajectory, as they alter activities and accumulate inscriptions. I would like to refer to two forms that I identify as central to managing the patient's trajectory: the F1 form (the medical-curve) and the F3.0 form (for viewing these forms, see Appendix E. 1, E.2, and E.3). As illustrated in the case study, these forms contain vital information about the medicines (F1), and about the blood test and examinations that had been requested by the physicians (F3.0). During the pre-round meetings, these forms which are kept in the curve books, are used by the physicians for retrieving information about the various examinations' results. The examinations' results

[50] "List-patients", in Norwegian: "liste-pasienter". These patients are registered in PiMS, and are expected to be admitted to the department.

that are accumulated in these forms, and the diagnosis, support the physicians in the process of decision-making. Physicians write information concerning medicines or examinations that should be requested for the patient. In this respect, these forms initiate and coordinate activities involved in ordering tests and medicines, and they function as a communication channel between the physicians and the nurses. In the case study, we saw how the assistant doctor writes the number "0" in the medication column in the F1 form, in order to indicate to the patient should not take his regular medicine. In other words, the assistant doctor used this form in order to give instructions to the nurse who will be on duty the next day, that there is irregularity in the medication (treatment). When the responsible nurse executes the task and enacts the doctor's order, she signs her initials on this form, indicating that the task had been completed. Hence, we see here how these forms (F1 and F3.0) allow both synchronous and asynchronous collaboration between the nurses and the physicians. In sum, these forms have a central role for organisational management, as they delegate, alter, and organise the work- and information-flow.

Moreover, the F1 and F3.0 forms play an active role through their layout. These forms are designed in a way that provide high tailorability, as they afford a quick retrieval and oversight of the examinations that had been performed, following the chronological order of the requests. The horizontal lines in both forms distinguish between previous and current requests, while the vertical lines separate between responsibilities. These are dynamic artefacts, as entries are constantly being added into the forms (Berg, 1999).

Another interesting issue that can be drawn out from the Parkinsons case is the role of the material presence of the artefacts. There are various routines and conventions that had been established over time, like for example the anaesthesia form (which is stored in a plastic cover, see figure 5.2.6) that are placed on the left side, on the table that is in the hallway, in order to communicate to the anaesthesia nurse that a patient is waiting for anaesthesia preparations. Another example illustrates how the material presence of the paper record in a fixed place, articulates the various activities. Depending on the paper record's material presence, activities are articulated. If for instance a paper record is placed in the doctors' office, it signals to the doctor that she/he should write the final epicrise, and if the record is placed in the secretary' office, it signals that the secretary should transcribe the epicrise, straighten up the record and send it to the doctor for verification and signature. When the record is placed on the trolley, depending on which shelf it is placed, it either signals that the record is about to be sent to the archive, or that the record has just been received from the archive. So far, we studied the artefacts' roles in the medical practice; in the next section, I will describe the artefacts' properties.

Artefacts' properties:

In order to understand how artefacts are embedded in the work practice, we must consider the artefact's central, peripheral, and shared properties. Artefacts with shared properties that cross borders between various communities are referred to as borderline objects. When viewing the paper record using these concepts, we see that it is part of a larger infrastructure that accumulates a group of *boundary objects*. Examples of these are the various documents and forms that were described in the Parkinsons' case study, which support the coordination of various processes. In addition, the paper record in itself can, to some degree, be seen as a boundary object that integrates various actors in a large and complex actor-network. Drawing upon the narrative description of the Parkinsons case, we see that the infrastructure of the patient record is being used and shared by many heterogeneous actors. Each actor represents one of the various occupational groups, such

as: laboratory personnel, surgeons, nurses and so forth. These groups are to some degree independent of each other, but they are interlinked together in an actor-network around the patient and the patient record. They have a common responsibility for the patient, and each one of them produces a small part of the comprehensive information in the patient record. This way, the paper record is a common resource that accumulates information from various occupational groups that can be interpreted differently in various work practices. The paper records become boundary objects that on the one hand have local meanings, and on the other hand are shared in a way that links these work practices together.

The information flow between the departments is very complex. In order to support this process, there are several forms that function as boundary objects that have been established. Epicrises and discharge forms for instance, are examples of artefacts that functions as a boundary objects (Dahl, 1998). These artefacts are central in managing patient's trajectory as they coordinate activities and accumulate inscriptions. The Parkinsons case outlines many different lists that are being used by the various personnel. Examples of such lists are: the patient-list, operation-lists, a list of the patients that are about to be admitted, patient-movement-list[51], and so forth. These lists can be seen as boundary objects, since these are used by the various occupational groups for different purposes. For example the patient-list is used by all the ward personnel that interact with patients: physicians, nurses, and secretaries. The ward secretaries use this list to keep track of the ward-situation and assist the nurse in remembering paramount tasks. The nurses use the list in order to fill in keywords about the patient that she is responsible for (i.e. diagnosis, appointments for examinations, whether there is a need for special arrangements or equipment etc.) Hence the various occupational groups use this list for various purposes. I chose not to go further into details, but rather refer to Svenningsen (2002), who has already provided a very nice analysis of the properties and roles of the patient-lists, as she describes the way EPR participates in the nurses' updating and reporting routines (Svenningsen, 2002, p. 122-129).

Borderline resources make focus on artefacts peripheral properties (inscription). Hence, when the paper record is implemented electronically, it becomes important to consider that, what was implicitly interlinked to the paper record's physical properties must now be provided explicitly. If this is overlooked in the transition process to electronic patient record, there will be a lack of the implicit information necessary for the coordination of work and activities.

6. 2. 3 –Implications for a transformation

The Parkinsons case was brought in order to explore the complexity of the medical practice following a work orientation. In addition, I tried to illustrate the link between individuals, artefacts and technologies, and the interdependencies of technologies and work practices. The case study shows how over a long time, the medical practice have been linked and supported by various artefacts. These artefacts have been linked to each other in the socio-technical network, and became part of the existing installed base of the infrastructure of the paper-based record. The case presents the various artefacts that surround the paper-based record, for example: numerous shelves, binders, archives, dictaphones etc. Gradually, the artefacts accumulated roles according to the way they

[51] The patient-movement-list gives an overview of the movements and transfer of patients in and out of the department.

were linked to work practices, and acquired the ability to trigger and coordinate activities. The Parkinsons case illustrates for instance how the patient record is interlinked to the work practices of the various groups in the neurology and neurosurgery departments. Patient records are used by doctors when diagnosing patients; they are used by nurses when treating patients, and secretaries when communicating with doctors. This shows the interconnection between the various work practices, such as administration, production of a patient record, diagnosis etc. There are various entities such as: humans, organisations, conventions, knowledge and skills, artefacts, and work practices; and these were interlinked, and aligned to each other to make the overall process work smoothly and efficiently. This implies that transforming one of these components will affect all these links in the infrastructure. An example of a transformation is the transition to electronic patient record, or the transition to electronic referral letters (which will be analysed in the next section). In both cases, the translation is more than just a replacement of the paper-based records or the referral letters, but also a replacement of the work practices and the routines that were developed around it (Lundberg, 2000). Hence, the transformation to an EPR is a mutual and dynamic process, which affects both the information infrastructure and the situated work practices. These have to be adapted and aligned to each other, and therefore, the transition process is complex and takes time. In the meanwhile, both the paper-based and the electronic patient record are being used simultaneously (both work practices are in use).

6. 3 – The Transition to Internal Electronic Referral Letters

The transition to internal electronic referral letters, describes an extension that was conducted in the infrastructure, which is part of the gradual transition to an electronic patient record. This is not a big and revolutionary case, but rather a case of a small and simple change. It is an incremental displacement of the referral letters which are part of the large and complex infrastructure, namely, the infrastructure of the medical record. The description and the empirical material (in chapter 5.3) covers a small-scale pilot project, which was expected to effect only two departments, and alter the work practice of mainly two occupational groups (meaning the physicians and secretaries). Drawing upon the Parkinsons case, we saw how the use of internal referral letters is only a small part of the overall medical practice. Due to its scale, this had been expected to be a simple project that would cause to minor changes in the work practices. However, drawing upon the empirical material in this case, we see how the implementation process of this project was complex and carried by a lot of negotiations and disagreements, especially concerning work practices and organisational issues. In other words, I chose to focus on the micro-aspects of how digitalizing such a small part of the medical work affects the overall infrastructure.

6. 3. 1 – The Implementation strategy

While analysing the empirical material from the transition process to electronic referral letters project, I will follow a work practice orientation. The development and implementation of this project shows how the IT department had been following a technology strategy. By this I mean, that many discussions and negotiations concerned technological issues, while little focus had been directed to the situated work practices as

well as organisational changes. This is also true when analysing the implementation case of DocuLive. I by no means wish to imply here that work practices were totally neglected, but rather to shed a light on the need for a greater focus on work practices. The IT department has been following a clear implementation strategy where they leave the responsibility for each department to decide and define the changes in their own work processes. In the implementation process of the EPR, we saw how there were several bottlenecks and complexities which concerned the changes in work practices and routines. An example of that, are the initial constrains that were faced due to the need for changing the physicians' routines for correcting and signing notes. Each department were given the responsibility to discuss these issues and to determine decisions for changes in the work practice. Hence, some departments decided that physicians will not change their situated work practice for correcting notes, while others decided that physicians must correct their notes by themselves. The implementation process of the electronic referral letters project also shows us how the final decision concerning changes in the work routines were given to the health care providers, and how discussion concerning complex routines: as emergency cases and weekends routines, were postponed.

The purpose with this case is to view the existing and complex work practice as installed base, and to show how work practices are so central that they can delay further implementation of the project in other departments. According to the situation today, the function of the electronic referral letters has been taken into use only by some departments. There are several departments that avoid using this function by sustaining on alternative ways for writing and sending referral letters (using the paper-based version). Thereby, the transition to electronic referral letters had been only partly achieved (to a limited degree).

6. 3. 2 – Artefacts and coordination work

The empirical material from this case, shows us how the paper-based referral letter is an artefact with properties that are significant in work practice conventions. The paper-based referral letters have peripheral properties (inscriptions) of being light and tangible. Their central property is to share and exchange information within the hospital and between various health organisations, but due to their tangibility and lightness they can also be placed on shelves, and tables. Such artefacts are more than just single and static objects; they are part of a shared infrastructure which the work practice depends upon. When looking at the description of the work practice before the transition to electronic referral letters, we see how the location of the paper-based referral letters has meanings beyond the traditional meaning of sorting and dividing the labour. We see how placing referral letter on the table of each group helps the physiotherapists to keep track of the status of work. In other words, the physical property of the paper-based referral letter plays a crucial role since it provides transparency and awareness of the workload to be carried out. When the referral letters are removed from the table, the convention that has been developed disappears. An example of that is when one of the physiotherapists picks up the piles of papers from one of the tables, in order to visit the patients and conduct the requested treatment. Moreover, the material and visible presence of the referral letters on the shelf, allows linking actions to events across the two departments (the neurology and physiotherapy department) without any personal interaction between the actors. So, when a neurologist wishes to request a treatment, he fills up a referral letter form and hands it over to the primary care nurse. Then she hands it over to the post secretaries, who places the letter on the shelf labelled with "physiotherapy". When the physiotherapist comes to

the neurology department, he fetches the letters from the shelf. Hence, the paper-based referral letter can be seen as an important common coordination object.

Applying this view to the interconnections between medical personnel and paper-based referral letters, enlighten the fact that the referral letters have several roles with particular meaning which keeps the medical work practice together. Drawing upon the description of the work practice that was outlined in the case, we see how the referral letter has ability to trigger and support coordination of work. Accordingly, in the transition to electronic referral letters, it is important to consider that what was implicitly interlinked to the referral letter's physical properties will disappear, and must now be provided explicitly. If this is overlooked in a transition process to electronic referral letters, there will be a lack of the implicit information necessary for the coordination of work.

6. 3. 3 – Implication for the design

Translating paper-based referral letters to electronic-based letters implies that the coordinated role of the paper document will be lost, and this must be replaced by the electronic systems. Therefore, to address problems of design, the interplay of the artifacts and the work practices need to be better understood.

For large coordination network as implemented in healthcare, and which is linked to various other artifacts, the coordination work can only be changed in a process were small sub-networks are replaced by new ones. The heterogeneous networks then need to be convergent and aligned by for example gateways that can link between the various sub-networks.

In this case, we can identify two sub-networks to be changed. The first one supports *predefined coordination work*, and contains the interplay of the paper-based referral letters with the various artifacts (shelves, tables, trolleys etc.). The new function of the electronic referral letters must be extended to provide more transparency and awareness of sequential interdependencies within the predefined structure of the work. The referral letters that are sent to the physiotherapy department are not referred to one specific physiotherapist. At the physiotherapy department, there is a physiotherapist who is responsible for routing and distributing the workload between the physiotherapists. There are some physiotherapists who are specialized for examinations sent from the Neurology and Neurosurgery department (e.g. Parkinson examinations). Some of the examinations are interlinked to a specific physiotherapist, while others are not. Lung-physiotherapy for instance can be evaluated and conducted by all the physiotherapists; therefore such referral letters are being distributed according to the physiotherapists who are on duty, the capacity and time. The different tables in the department make this distribution of the workflow more visible to each physiotherapist. A glance on the table gives a quick overview of the day's schedule workload. Hence, the visibility aspect is important in the division of labor and job rotation at the department. In the transformation to electronic referral letters, this aspect is lost and should therefore be compensated by the information system.

The second sub-network is the resource supporting overview in the *situated coordination*. Those activities are not pre-defined, and they occur when unexpected contingencies in work process (such as emergency cases), and require ad-hoc coordination and collaborative work (e.g. ad-hoc discussion with clinicians, computer work with DocuLive retrieving former medical information etc).

6. 3. 4 – Gateways-practices

The case of the transformation to electronic referral letters sheds a light on the challenges that are faced when abstract design principle meets the situated work practice. One of the challenges that can be identified concerns changes in the work practice. When the electronic referral letters were taken into use, adaptations in the work routines were conducted. Since there is only one computer (that has DocuLive) in the meeting room, each neurologist who wanted to fill up an electronic referral letter had to log in and out from DocuLive. This was not an optimal solution as it was very time consuming. Therefore, the physicians in the neurology department established gateway practice (also referred to as 'work-arounds'), where they decided to allow the physician who is already logged into DocuLive, to write the electronic referral letters for all the physicians. This instead of wasting time in sending each referral letters to the responsible physician for signature. This change in the work practice had been established in order to compensate the "gap" between the new technology and their context dependent work practice. Consequently, the physician who writes and signs the referral letters is not the one who requested them. The case shows us how the neurologists reorganised the existing responsibilities for writing and signing referral letters, in order to link the existing work practice with the digital form.

Similar to the neurology department, gateway practices were also developed in the physiotherapy department. Drawing upon the description of the altered work practice, we saw how the physiotherapist who is responsible for the division of labour, prints out all the referral letters and distributes them respectively between the six groups of physiotherapists. Just like before the transformation to electronic referral letters, the physiotherapist places the letters on the table of each group. The paper-based referral letters have a coordinating role when these are being distributed between the health personnel in the various departments. In addition, a pile of papers is visible and represents the state of work. When the referral letters are transformed to electronic form, they become invisible. Therefore, there is a need for compensation that will make them visible again. DocuLive affords only a general list over all the *untreated internal referral letters*, yet it does not afford a personalized list for each group. Therefore, the physiotherapists developed a gateway-practice where they print out the paper-based referral letters and place them on the tables.

The transformation to electronic referral letters had an impact on the work practices in several ways. Using electronic referral letters increased the rapid access to referral letters; once the physician signed the letter, it was visible for the physiotherapists. In addition, bypassing the long and somehow risky chain of actors and activities, increased the speed of the sending process, and reduced the likelihood of loosing or misplacing referral letters. However, when the paper-based referral letters were replaced with electronic ones, the achievements in work were insignificant. In the macro-level, there was no change in the tradition sequence of activities. The physiotherapists were still printing out the letters and putting them on the tables (in order to divide the workload). But when zooming in to an activity-level, changes in the performance (who, how, where and when) can be identified. When comparing between figure 5.3.3 and 5.3.4 (in section 5.3), we see that there were changes in the actors and the way they perform the activities. After the transformation, the responsibility for writing referral letters to the physiotherapy was transferred from the secretaries to the physicians, and this was done using DocuLive and filling up an electronic form.

The transition to electronic referral letters had an impact on the interdependencies as well. As already mentioned, the physicians were given the responsibility to transcribe referral letters into DocuLive, instead of continuing the old chain of translation where doctors dictate notes and hand them over to the secretary for transcription. Drawing upon the empirical case, enlighten how immensely difficult it was to change the existing division of labour. The decision that was taken concerning the additional work, arose complaints from some physicians. Due to fact that physicians were given the responsibility to transcribe and referral letters, they became less dependent on administrative staff (e.g. secretaries)

6. 3. 5 – When abstract design principles meets the real work practice

The challenges that were related to changes in the work practices, increased (accumulated/ called for) the need for customizations in terms of redesigning the terminology in the electronic version of the referral letters.
As mentioned previously, due to the gateway-practice that was established at the neurology department, the physician who writes and signs the referral letters is not the one who requested them. In the electronic referral letter, there are two fields where one is for writing who requested this treatment: "*Requested by*"[52], and the other one is for the physician's signature: "*Signature*"[53]. Eventually, it became important for the physicians in the neurology department to distinguish between the fields, and they decided that the name of the physician requesting the treatment or evaluation would be registered in the "*requested by*" field. Clarifying this issue was important, in order to make sure that the reply-note from the physiotherapist will be sent to the neurologist who ordered the treatment/evaluation (and not to the one who wrote and signed the referral letter).

Similar discussion concerning the need to clarify or change the imprecise use of terminology arose in the physiotherapy department. Due to the fact that in the physiotherapy department there could be several physiotherapists who are responsible for one patient, having only one field (in the electronic version) for registering: "*the person treating*"[54] can be limiting and problematic. A possible solution that was proposed was to change the term "*the person treating*" to the term "*received referral letter*"[55]. The physiotherapists explained that they have many students in their department, and when a student perform a treatment or an evaluation, they have to be contra-signed by a physiotherapist who takes responsibility for the treatment. Therefore, they find it important to distinguish between the physiotherapist who performed the treatment, and the one who received the letter and stands responsible for the treatment.

6. 3. 6 – Consequences

After analysing the trajectory of writing and sending referral letters before and after the transformation to electronic referral letters, we can see how previous problems were solved, but at the same time, the new tasks introduced new "loose-ends" and weak spots, which could lead to potential problems.

Replacing paper-based with electronic referral letters solved the previous problems that were encountered. The speed of the sending process of a referral letter was

[52] "*Requested by*" is a translation of the Norwegian term: "*Bestilt av"*.
[53] "*Signature*" is a translation of the Norwegian term: "*Signering*".
[54] "*The person treating*" is a translation of "*behandler*".
[55] "*Received referral letter*" is a translation of "*henvisning mottat*".

increased, and the likelihood of loosing or misplacing them was reduced. However, the transformation to electronic referral letters gives also rise to new tasks and challenges; new weak spots and dilemmas. One of the weak spots refers to the discussions that were previously introduced concerning the use of terminology. Due to the new work-practice, it became paramount to distinguish between the neurologist who writes and signs the referral letter, and the one who request it. And at the physiotherapy department, it became important to distinguish between the physiotherapists who conducted the treatment or evaluation, and the one who stands responsible for it. Hence, the electronic referral letter created new situations that did not exist before.

The transformation to electronic internal referral letters implies that the referral letters become invisible. The health care personnel do not see a pile of papers as they used to before. Instead of fetching a pile of paper-based referral letters, the physiotherapist log into DocuLive and check the electronic list. Hence, we see here how a pile of papers had been compensated with an electronic list which represents the current workload.

The neurologists on the other side do not have any list that can provide them an overview over the unsigned referral letters, or the letters that were sent. This implies that if a neurologist writes a referral letter to the physiotherapy department and forgets to sign the letter, this is not visible in any list (such situations arise when a neurologist write a referral letter and close the document without signing it). In DocuLive, there is a list that provides an overview over the unsigned notes, but this does not include referral letters. If the referral letter was paper-based and the neurologists forgot to sign it, then the nurse or the secretary who often double-checks that all the field in the form had been filled up, would have noticed that and handed it back to the neurologist. But when going to electronic format, this is not visible and the neurologists do not receive any confirmation when sending the referral letter. The only thing that can signal the neurologist that he forgot to sign the referral letter is the watermark in the background indicating that the letter is a rough draft. But this is visible only if the neurologist opens the letter. Situations as this one have already arisen and patients were kept in the department waiting for their medical-supervision from additional departments. Thereby, in the next section I will go on to discussing the need for gateways that can make the work practice and information flow visible.

6. 3. 7 – The need for gateways

According to ANT, changing one component in the actor-network, will affect other components in the entire network. The case shows us how the transition to electronic (internal) referral letters effects the routines that were developed around the paper-based referral letters, and thereby, has an impact on the existing work practice and coordination work. It is not merely a translation of the paper-based referral letters to electronic, but also a replacement of the entire paper-production process. The case describe how the paper-based referral letter supports the situated work practice, and how it is surrounded by multiple artefacts that preserve a smooth flow of work.

We see in the case how the various components (e.g. conventions, knowledge and skills, artefacts, and work practices), are interlinked and aligned to each other to make the overall process work smoothly and efficiently. This implies that when the paper-based referral letters were replaced with electronic ones, it affected the links that the paper

letters had. Consequently, these links do not “fit” to the new technology, meaning the electronic referral letters. Gradually, the situated work practices and the new technology of electronic referral letters were aligned to each other, and gateway practices were established. In order to bridge (link) between the two incompatible components (the work practices and the electronic referral letters) in such a large network, gateways should be developed.

As I mentioned earlier, when transforming to electronic referral letters the workload is not as visible as before, when the health personnel could have a look at the piles of papers on their tables when passing by the hallway. The visibility aspect is lost and should therefore be compensated by, for instance, an electronic list that can function as a gateway when transforming to electronic referral letters. An example of that can be a personalized electronic list that can virtually represent these tables, and afford an overview of the current state of work for each group of physiotherapists. At the current stage, DocuLive contains a list that can give an overview of the untreated internal referral letters, but it does not contain a personalized list that can support the coordination of work. Due to the fact that the division of workload is a complex process that depends on multiple issues (e.g. the physiotherapists that are on-duty, the urgency of the request etc.), this can be compensated by having a physiotherapist who will distribute and route the general electronic list of the referral letters between the physiotherapists. By having a personal list that can virtually represent the workload for each group, there will be no need for printing out referral letters and placing them on the tables. This way, the electronic lists will compensate the pile of papers on the tables and allow collaboration work. Another proposal can be to generate a list for the sender (in our case, the neurologists) that will provide an overview of the “untreated referral letters”, meaning those that have not been replied yet (similar to the one that the physiotherapists have). As the situation is today, the neurologists who send the referral letters do not have a list that can provide an overview of the letters that were sent. The only way to see it, is to look in the electronic record for each patient. In addition, there should be a supplementary list for the neurologists where they can have an overview of the referral letters that has not been signed (or has not been sent). Referral letters are being written during the pre-ward meetings, where decisions and activities must be conducted fast, as physicians have to go through all the patients. Consequently, it is very easy to make mistake and forget to sign an electronic referral letter. Before the transformation to electronic referral letters, the secretaries or the nurses would usually check that the physician filled up all the fields in the paper-based letter. However, this had been changed as the physicians received the responsibility to write and send the referral letters. Observed phenomena already showed cases where physicians forgot to sign the electronic referral letter. Due to the fact that this was not visible in any list, the patient ended up laying in the department for three days, waiting for a reply for a treatment. Lundberg (1999), who studied the implementation of PACS in the radiology department, describes how initially, electronic lists were seen as insignificant solution in the larger PACS. Then she describes how lists proved to be important for coordination work, and how the radiologists rapidly invented new kinds of lists (as working-list). In her article, she asserts the importance of exploring and acknowledging the properties of electronic lists as they have the ability to support the management and organisation of individual and interdisciplinary work, and the potential to improve performance and efficiency in work (Lundberg, 1999).

Beside electronic lists, there are various ways to enhance the visibility of the workload and to trigger articulation of work (activities). One way to do it, is to enhance the user-interface of the digital forms. For instance, the icons in the general menu (in DocuLive) can be designed in a special way that they will represent the workload, or indicate whether the referral letter was evaluated or not (if it has a reply-note). This way, the neurologist can see if a referral letter has not been evaluated yet, without being forced to open each patient record, and each letter. Such electronic lists and enhancements in the interface, will support *predefined coordination work*.

In addition, there are different ways to support *situated coordination work* (e.g. emergency case). One way is to provide the possibility to receive messages in real time. This implies prompting a message that will inform the physiotherapists each time a new referral letter is received, or a message that will inform the neurologists each time a treatment or an evaluation is completed. However, there are several unclear issues that must be discussed prior to the implementation of this function, such as who will receive the various referral letters, who will have access to which parts of the information, etc. In summary, at the current stage, DocuLive is not a complete system, as it lacks additional functionality and integration with other systems. In addition, DocuLive lacks support of the workflow and work processes. This can be achieved by developing gateways and translation devices that can link between the situated work practice and the new technology of the referral letters.

In summary, the case supports what Rolland's argument (2000) concerning the importance of acquiring a better understanding of the artefacts and the situated practice of use, as they preserve a smooth flow of work and keep the medical work practice together. In addition, the case supports what many IS researchers emphasise, referring to the understanding and representation of the real work practice, and recognizing the importance of making it visible (Hughes, King, Rodden and Anderssen, 1994; Lundberg and Sandahl, 2000; Lundberg and Tellioglu, 1999; Suchman, 1995)

6. 4 – The Scanning Project

The scanning project is a tremendously large and complex project that will require radical changes in the existing work practice. Accordingly, the project will have major consequences for all the healthcare personnel. Drawing upon the empirical material, which describes the test-phase of the development and implementation process of the scanning project, we see how large and complex the project may become. The description of the current status of the local scanning in the pilot departments sheds a light on the importance of implementing clear and coordinated work routines for scanning. This should include information about what should be scanned, when and where to place the various digital documents. In addition, final decisions must be taken concerning the division of labour and responsibilities. In this section, I will first shortly describe the existing infrastructure that the scanning project will affect, as well as the installed based that have an impact on the implementation process. Thereafter, I will discuss how to manage the gradual transition of going to digital patient records. I then choose to view the scanning project as a gateway, and finally discuss the implications for change.

6. 4. 1 – Meeting the local installed base

Drawing upon the current status of the local infrastructure in section 3.2, we recognize how fragmented and hybrid the infrastructure of the patient record is. Among the others, this includes various non-integrated IT systems that are being used along the side of the EPR. In addition, the paper-based records are used simultaneously as the EPR. As previously mentioned, the paper-based records are fragmented as local sectioned emerged within the common record. Thereby, the paper-based record contains redundant information. The scanning project will enforce and impose changes on the work practices, and on the existing fragmentation in the paper-based record in few departments. However, within the implementation of the scanning project in all the departments, it is important to acknowledge the importance of the existing installed-base and its heritage on the new infrastructure. One of the healthcare personnel expressed her opinion about the scanning project in the following way:

> G: ”*When it comes to scanning, before one starts to implement the scanning project, strategic decisions should be taken concerning the implementation of one common record otherwise, there will be a jumble. Today, we have in reality one record* [section] *for each clinical department gathered in one record”…*

Drawing upon the Parkinsons case, we recognize how the existing infrastructure of the paper-based record is linked to various technologies, heterogeneous actors, and multiple artefacts. The various artefacts are highly interdependent and linked together with the work practices. This implies that the artefacts and the work practices had been linked together into a large socio-technical network, and became part of the existing installed base of the paper-based record. The links and mutual interdependencies of technologies and work practice, implies that the existing installed-base will effect and may constrain the new one. Hence, scanning all the paper-based documents that are being used will have a high impact and enforce changes in the existing fragmented and hybrid infrastructure. Thereby, within the development and implementation process of the scanning project, it is important to acknowledge not only the existing installed base of the information systems, but also the installed base of the situated work practices. Both are interdependence and carries heritage for the new digital infrastructure.

6. 4. 2 – Managing the gradual transition

Using the vocabulary of actor-network theory (Callon, 1991), we see how the various interdependent components in the large actor-network of patient record are aligned. Since the immense installed base of the paper-based record, users, conventions, knowledge and skills, experience and practice, software etc., is well-aligned, it might develop to some extent an inertial state. Accordingly, the complex infrastructure of the patient record cannot be changed instantly. Only few components of the actor-network can be replaced at a time. Thereafter, the components that had been changed, must be convergent and aligned with the rest of the actor-network. However, it is important to mention that the fact that the paper-based records are doubling in size, implies that the cost and duration of the transition, in terms of transition and manpower, is also increasing. This implies that the time it will take to implement the scanning project in all the departments, will directly affect the costs of the transition process. As the time goes by, the amount of papers to be scanned will increase, it will be harder to remove the local section within the common record, and it will be more difficult to undertake the transition process.

As previously mentioned, due to the fact that the various interdependent components in the large actor-network of patient record are well aligned , changes must be conducted following an evolutionary approach. There are several ways to conduct a gradual transition, like for instance, through incremental extensions and developing gateways. Drawing upon the historical background in the third chapter, and the empirical material in section 5.1 (the implementation process of DocuLive), we saw how the gradual transition from paper-based to electronic patient record was implemented by following incremental changes, including customizations, ad-hoc modifications, and extensions. Subsequently, I described in section 5.3 the transformation to electronic referral letters, while viewing it as one of the extensions that were conducted in the EPR. Now, in the following section, I choose to view the scanning project as a gateway.

6. 4. 3 – The scanning project as a gateway

In the empirical material, I introduced two major motivations for implementing the scanning project. The first motivation refers to viewing the scanning project as a temporary sub-optimal solution for handling the crises in the archive department. I would like to draw upon the second motivation, which refers to viewing the scanning project as a temporary ad-hoc solution for the existing hybrid and fragmented medical records. At the current stage, there is a lot of information that do not exist in a digital format. The electronic patient record contains only some of the text-based forms, while 20-30% of the information in the paper-based records is not included in the electronic record. Moreover, there are various types of information that are being produced from other systems than the EPR. Due to the lack of integration between these systems and the EPR, this type of information (e.g. ECG's) exists only in the paper-based records. Others types of information that do not exist in the electronic record are those which had been registered before the implementation of DocuLive (e.g. old records). Thereby, the scanning project can be viewed as a gateway, which will bridge between the paper-based and the electronic patient record. In other words, this project can be seen as a 'translation device' that will allow parallel coexistence of the two networks, and avoid breakdown in the chain of work. Since the scanning project includes also scanning external referral letters and other incoming post, this implies that the scanning project will integrate between the external information that is sent from other organisations, and the internal information that is produced in the various departments.

Summing up the above mentioned, the scanning project can be viewed as a gateway that will link together the paper-based and the electronic record, which are two incompatible, independent networks. This link will provide integration between the two networks of patient records, and can prospectively allow merging the two (if desired). In addition, it will function as a gateway which will link various types of information, such as: text-based information, graphical pictures, etc. By scanning the various types of paper-based documents, they will be translated into one common format (a picture format- TIF), and will then be transformed and merge with the electronic patient record.

6. 4. 4 – Implications for change

As described in the empirical case, it will demand a period of time to scan the huge amount of documents of the existing active patients in the entire organisation. Thereby in the meanwhile, paper-based and electronic records will be used side by side. Due to this redundant and hybrid work practice, it will become paramount to keep continuous track of which paper records and documents have been scanned, in order to avoid double

routines. Moreover, due to the number of actors participating in the project (the personnel from the central archive, and health personnel from all the departments) the scanning routines must be conducted following highly coordinated routines. The scanning strategy, which includes both central and local scanning, must be well planned. In addition, final decisions concerning responsibilities and the workload division must be taken. Lack of a clear strategy will slow or even break the implementation process.

In the gradual transition from paper-based to electronic patient record, I tried to illustrate how going to electronic-based records is a long and complex process that affects the various underlying information infrastructures within and between the various departments. Thereafter, when discussing the transition to electronic referral letters, I tried to show how this is not merely a technical replacement of the paper-based referral letters. I tried to illustrate how the transition will have an impact on the situated work practice and the interdependencies, as well as the various artefacts that supports the underlying medical practice. Similar to the other transformations, the scanning project will affect the entire socio-technical network. In other words, scanning all the paper-based documents will have consequences on other components in the entire network. However, what distinguishes the scanning project from the previously mentioned transformation-cases (to EPR, and electronic referral letters), is that the scanning project will enforce radical changes that might have higher consequences. According to the pre-defined scanning strategy, the overall aim is to have all the information in digital form, and to subsequently shred all the paper-based records. However, moving towards a paperless hospital can be immensely complex in relation to the implications of such changes on the work practices, especially on the routines around the paper production and flow that are used in the entire hospital.

6. 5 – Summary

In this section, I will briefly sum up the main issues that were covered across the various cases. Across all the cases in the analysis (except the Parkinsons case), I tried to hold infrastructure focus together with a work practice orientation.

I started by analysing the implementation process of the EPR by following an infrastructural focus and emphasising the importance of acknowledging the installed base. I tried to illustrate in both the transformation to the EPR and to electronic referral letters, how the existing installed base carries heritage and is affected by the former installed base (the paper-based record and referral letter). Thereafter, I related this to the scanning project, and explained that the existing hybrid installed base (of both paper and electronic records) may affect and constrain the new one. I tried to show how the installed base of the EPR had to gradually evolve and scale through extensions and improvements, and provided an example of extending the EPR to include electronic referral letters.

The existing hybrid installed base lead to the need for integration, and finding transition strategies to deal with scaling and evolving information infrastructures. One way to integrate the various information technologies, is to apply gateways that can link the paper-based and the electronic patient record together. I chose to view the scanning project as a gateway, since it functions as a translation device that allows communication between the two incompatible and independent information infrastructures.

However, I tried to illustrate that the transition process to an EPR, is not merely a transformation of information infrastructure. This was also argued in the transition to electronic referral letters, as the translation is not merely a replacement of the paper-based referral letters. The transition process in both cases, as well as in the scanning case, is rather mutual, dynamic, and reflexive transformation process of both information infrastructure and situated practices of use. Thereby, I chose to hold infrastructure focus together with a work practice orientation and *use* focus.

The Parkinsons case was brought in order to explore the complexity of the work practices. In addition, the case illustrates the link between individuals, artefacts and technologies, and the interdependencies of technologies and work practices.

In the transformation to the EPR, I analysed the impact that it had on the work practices and the interdependencies of work. I argued that the achievements in work were insignificant, and that the change could be identified only on a detailed activity-level. The same had been illustrated in the transformation to electronic referral letters, where I illustrated how there were no radical changes in the traditional sequences of activities, and how changes could be identified only in the performance of the activities. In addition to that, I identified changes in the interdependencies, where in both cases (the transition to the EPR and electronic referral letters) physicians became less dependent on administrative staff (e.g. secretaries).

I tried to illustrate across all the cases, how the work practice of the healthcare personnel is linked and supported by a long chain of artefacts that have various roles and properties. I analysed the inscriptions of the paper-based record and compared these to the inscriptions of the electronic patient record. Then, in the Parkinsons case, I tried to illustrate how the paper-based record is a part of a larger infrastructure that accumulates a group of boundary objects. Thereafter, I analysed the peripheral properties (inscriptions) of the paper-based referral letters, and illustrated how these are more than just static objects; placed on shelves. Such artefacts have the ability to trigger activities and support coordination work.

Translating paper-based to electronic records implies that the coordination role of the paper document will be lost, and must be replaced by the information system. This implies also to the translation of paper-based referral letters to electronic ones. Due to the fact that artefacts, work practices, knowledge and skills etc. are interlinked and aligned to each other, the transformation one of these components will affect all these links in the infrastructure. Thereby, it is important to find ways to manage a gradual transition, and to conduct changes while avoiding breakdown in the whole chain of work. This for example, can be done by conducting extension and improvements of the installed base, as well as identifying borderline issues and establishing gateways

In this section, I will briefly sum up the main issues that were covered across the various cases. Across all the cases in the analysis (except the Parkinsons case), I tried to hold infrastructure focus together with a work practice orientation.

7. Discussion

I choose to divide the discussion into two parts: first, I will discuss the implications of the empirical cases and the analysis for theory. I will discuss the information infrastructure perspective, and compare it (to some degree) to practice oriented concepts from the CSCW field. In addition, I will discuss the benefit of merging the two perspectives. In the second part, I will discuss the practical implications for organising and managing change, by lighting up the different challenges within the transition to an EPR. By reflecting on my experience I will suggest some normative implications for how to organise and manage such processes. .

7. 1 – Theoretical Discussion

7. 1. 1 – Mutual and dynamic transition process

An information infrastructure is large and tightly interconnected network, constituted of heterogeneous socio-technical elements. Gradually, an infrastructure has to evolve and scale through extensions and improvements, in order to meet the new requirements. However, drawing upon Monteiro's description (1998), the process of scaling an infrastructure is caught in a dilemma. The expanding infrastructure accumulates pressure for making changes, however, this has to be negotiated and balanced against the conservative influence of the existing installed base. This influence refers for instance to the technical, economical and organisational investments (Monteiro, 1998). The complexity related to the design of information infrastructures in terms of balance is also described by Rolland (2002b), who explains how the need for standardization and interconnections across contexts have to be balanced against the need for flexibility and customizability in local context.

Changing such a large and complex infrastructure, as the medical infrastructure, is profoundly challenging. The literature on information infrastructure design focus on the heritage of the installed base, and the importance of finding strategies to manage gradual transitions. However, this perspective does not provide us knowledge about the organisation of the situated work practices, or tools to understand the roles and properties of artefacts in the medical practice. This knowledge can be obtained by using practice-oriented concepts from the CSCW literature. Yet, following only this practice-orientation neglects the importance of the installed base of the information infrastructure. The transition process is a mutual, dynamic, and reflexive transformation of both information infrastructures and situated practices of use (Rolland, 2002b). Therefore there is a need for exploring the complex interplay that exists between the two. The study shows us how implementing an electronic record systems, or even parts of it such as electronic referral letters, changes not only one element in this interplay between the paper record, but also the work practices that were developed around it. However, the medical record and the work practice are not singular elements, but rather part of a large heterogeneous socio-technical network that includes artefacts, tools, people etc. Therefore, I applied to this thesis a theoretical framework that holds together infrastructural focus, and a work practices orientation while emphasising the *use* aspect.

7. 1. 2 – Implications

The previously mentioned complex interplay between situated work practices and innovation processes of information infrastructures has various implications. Using the lens of information infrastructures shows us the elements of the community of practice, including actor and activities. However, using work oriented concepts to describe situated practice of use, and viewing them through ethnographic eyes, allow us to go between layers and analyse formal and informal aspects of communication, as it focuses attention on fringes and materialities of infrastructures, of *how* activity is done (Star, 2002). This implies that we acquire a better understanding of the technology in context, as well as the social structures, like values and work practices embedded in the various tools.

The way I use Information Infrastructure perspective describes issues on a general level, as it provides a framework for the socio-technical aspects and presents the elements in the infrastructure. This perspective focuses on '*who'* the actors are and *'what'* are the activities (processes). However, it does not explain the meaning and roles of these elements, and thereby, it does not emphasise how actors and activities are interdependent and interrelated to each other. In other words, the information infrastructure perspective neglects the sequence of the activities, interdependencies, and unexpected contingences. As opposed to the work practice orientation which has a process oriented view, this perspective has a structure orientated view on the workflow. In other words, the information infrastructure perspective provides a static understanding of the activities, while neglecting i.e. unexpected contingencies.

By using theoretical concepts from studies conducted within CSCW, I gain the possibility to zoom in to a deeper level, focusing on work practice and unpacking micro-elements as artefacts down to their empirical constituents. This orientation focuses on *'how'* the actors and activities are interdependent and interrelated to each other. For instance, by drawing upon the concepts of illness trajectories and articulation work (Strauss, Fagerhaugh, Suczek, and Wiener, 1985), we view the information and the workflow as a dynamic process. We recognize that trajectories are not simple and linear, and we take into account additional aspects, such as unexpected contingencies.

As previously mentioned, I use the information infrastructure perspective in such a way that it describes issues on a general level, unpacking elements in the infrastructure (actors and activities). By using theoretical concepts from studies conducted within CSCW, I gain the possibility to zoom in to a deeper level, unpacking micro-elements (e.g. artefacts). Therefore, by holding together the two perspectives, I acquire the possibility to zoom in and out of a situation as required, as well as flexibility to move up and down in the analysis.

In addition to that, the information infrastructure perspective views artefacts as an element in the information infrastructure. For example, paper-based documents (e.g. referral letters) are seen as a static carrier of information. As opposed to this, the work practice orientation emphasise the meaning and roles of artefacts. Paper-based documents for instance are used for information flow and management, and they have the ability to support synchronous and asynchronous collaboration activities (Luff, Heath, and Greatbatch, 1992). However, artefacts are more than 'transparent' and 'supporting', as they accumulate inscriptions and coordinate activities (Berg, 1999). Moreover, artefacts can be view as links that joints various processes (Hanseth, and Lundberg, 2001), as they trigger work activities and support coordination. In addition, artefacts have important

properties that can be explore by applying for instance the concept of borderline issues (Brown, and Duguid, 1994; Star, and Griesemer, 1989)

Summing up the above mentioned, the information infrastructure perspective lacks focus on issues that are being illuminated by the work practice orientation and vice versa. Aiming to understand change and transition process of an information infrastructure, I chose to merge the two perspectives as they together provide a broader and integral understanding of the process. My objective in this discussion was not to advocate one perspective or another, but rather to shed light on the need for merging the two perspectives. I chose to view both the existing infrastructure and the situated work practices as installed base, which carries heritage that heavily influence the design of the new infrastructure. The transition process is mutual, dynamic, and reflexive, where technologies and work practices evolve together. However, evolving such a large and complex information infrastructure as the EPR is profoundly challenging. The pressure for conducting changes must be balanced against the conservative influence of the existing installed base. Thereby, there is a need for strategies to manage and handle such a gradual transition process, like for instance cultivation and gateways which can link various elements. Cultivation allows the socio-technical infrastructure to extend and evolve over time. Extensions and improvements of the tightly aligned components must be conducted gradually, following partial stepwise changes of few components at the time. Then these components are gradually aligned to the existing actor-networks. Part of the alignment is obtained through gateways-practices that the actors establish in order to link the various work practice. In contrast to technological determinism (where the installed base is the only actor having power), cultivation is seen as a middle position that captures the role of both humans and technology.

7. 2 – Practical Implications

In the previous section, I discussed theoretical implications of combining two theoretical perspectives for understanding how to manage a gradual transition to the EPR. I illustrated the importance of acknowledging the installed base as well as acknowledging social aspects (e.g. work practices, artefacts). In this section, I would like to bring forward the human and the situated work practice, by illustrating how technological changes as such affect the people; their attitude, conventions and routines. As my interest is to explore strategies for managing gradual transition, I wish to reflect on my experience from the implementation process of the EPR, and from the observed phenomena of organisational choices. Having focus on the technical infrastructure does not take into account issues such as embodied practices, sub-optimal use, people and artefacts. I view the transition process as mutual, reflexive and dynamic where both technology and work practices evolve together, and within the transition, it is important to acknowledge both the installed base of the existing infrastructure, and the work practice as an installed base. Thereby, I would like to reflect upon several practical implications for organisation of change and managing a gradual transition in such a large and complex organisation network as Rikshospitalet.

In this thesis I have discussed and analysed three empirical cases: the development and implementation process of the EPR, the implementation of the electronic referral letters,

and the initial phase of the scanning project. Each case was unique and constituted of different challenges and complexities. However, there were a certain constraints that were continuously faced in all the cases except the scanning case[56].

Drawing upon the introduction of the EPR, the electronic referral letters or the scanning project, I learned that conducting such a change of both the infrastructure and the work practices is very challenging. Rikshospitalet is a large and complex healthcare organisation which is constituted of hierarchic and heterogeneous occupational groups. Thereby, it is important to choose appropriate communication channels to distribute information. Based upon observed phenomena from the electronic referral letters' case, the health care personnel were not informed properly about the project. This can also be applied to the EPR case, where many of the health care personnel lacked knowledge about the routines that the IT department have for updating the server. Another example is that many of the personnel whom I talked to, did not know who were the super-users and user-contact for their occupational group, in their department. After exploring the issue of the communication channels that were used, I understood that the IT department uses the intranet (Riksnett) in order to publish and distribute information concerning e.g. courses, and dates for updating the server. However, based upon some of the comments that I received from users, some have never used the intranet and others claimed that they did not have time to "surf on the net" when they were at work. Other types of information are being distributed by sending mails to the head of the departments, the office directors, and the head nurses. Some of these actors have local routines were they print out the mails (from the IT department) and hang them on the blackboard in the ward, others announce the information during the local meetings, and gradually, there are more actors who forwards the mail to the personnel in their occupational group. However, this is not always practiced in the different departments and the various occupational groups. Thereby, the information is not always channelled appropriately to all the personnel, and the lack of awareness could result in lack of commitment and motivation. As can be seen here, the heterogeneous situated work practices and skills that exist in the various departments were not taken into account. The fact that not all the health care personnel were familiar with the intranet or mail programs, caused a break in the communication channel between these users and the IT department.

As previously discussed in chapter 3 (section 3.3) the IT department had been using a mixed-strategy of both imposed and voluntary changes. The healthcare personnel were obliged to use DocuLive EPR and the electronic referral letters. However, the degree of use of those functionalities was voluntary rather than mandatory. The IT department invites the health care personnel to adopt new work routines or to use a new system by emphasising its advantages and benefits, but they preserve local autonomy and do not control whether the health personnel are following those routines. However, the fact that the IT department have no centralized management control, makes it incredibly more complex and challenging to conduct changes. When implementing a change, there should be a balance between the imposed and voluntary control. As the IT department use an implementation strategy of voluntary changes, patterns of interdepartmental resistance for change (Goffman, 1974) may occur, and it is not always visible on the surface of the

[56] It is worth to mention that I do not have sufficient knowledge about the detailed implementation strategy that was used in the scanning project

overall infrastructure. This leads to the next issue, which refers to the importance of having interdepartmental strong and active leadership.

It has been shown that it is difficult to find ways to implement changes in work practices. When introducing a new project in a department, it is therefore important to gain support from the head of the department, the office director, and the head nurses. These leaders can have a higher impact and encourage a stronger involvement from the health personnel. An active leader can encourage or enforce changes and adopting of new routines for the clinical practice (the IT department is considered as an "outsider" in this matter). For instance in one of the departments, the leaders decided that the physicians should correct notes by themselves (instead of sending them to the secretaries). However, in other departments, physicians did not initially follow this practice, as they were given the possibility (during the courses) to choose work practice.

Having support from the leaders is important, but since the various projects accumulate changes that will affect the medical practice of the health personnel, it is also paramount to inform them about the following changes and to gain their support. Buy using a strategy of choosing contact persons and super-users for each occupational group; the IT department invites an active participation of the health personnel in the implementation phases. However, my observations show that it might not be reasonable to choose actors as head of departments, or head nurses, to be contact personnel- as was done in the implementation process of the EPR. This is due to the reason that they often are hard to reach, that they have many responsibilities, and that their daily work is very time consuming. Choosing one contact person from each occupational group is a reasonable strategy, but it is important to choose the personnel that will be affected by the implementation process. In the implementation process of the electronic referral letters, a secretary from the ward was chosen to represent the secretaries in the expedition. However, those two groups of secretaries have different responsibilities and work practices, and the implementation of the electronic referral letters does not affect directly the secretaries' work practice at the ward. This shows us how the various heterogeneous actors in this complex socio-technical infrastructure, carries different activities. Hence, it is important to consider the impact that the transformation process will have on work practice, and to identify the actors who will be affected by the transformation.

The empirical material that was collected from two departments during the implementation of DocuLive sheds a light on the importance of having extensive supporting layers (meaning IT support for the users). When going backstage, behind the scenes, we see how there were several problems with technical devices that could be avoided. Based upon the empirical material from one of the departments, it seems like these kinds of issues (e.g. having stable printers), had been abstracted away. It had been taken for granted that installing new technological devices was reasonable enough. However, looking deeper at the invisible layers of the complexities that were faced, we see how printer were not connected properly to the various computers, and how some of the computers were not stable enough to use two programs simultaneously (i.e. PiMS and DocuLive). Another example is the long printing-queues that were not taken into consideration in one of the department, as there were not enough printers. The empirical cases show us how complex it is to implement such a change in such a complex and large organisation. In addition, we see how apparently minor issues, as a printer that does not

work, can delay the work and information flow (in our case, delay the meetings). Therefore, implementing such a change requires extensive supporting layers. When I shared parts of my empirical data with one of the staff from the IT department, he pointed out that they should have had a better supporting-network. Drawing upon the information infrastructure perspective and a work practice understanding, sheds a light on the fact that the new infrastructure of the EPR is built upon the existing installed base of both technologies and work practices. These evolve together in a mutual and dynamic transition processes. Rather than thinking in term of constructing the EPR system, we should view the development process as cultivation of the system. Cultivation allows the socio-technical infrastructure to extend and evolve over time. Therefore, it is important to provide supporting layers for both technological issues and social aspects (referring to work practices).

Finally, I would like to mention another challenge that is faced concerns providing courses, teaching sessions and support in the field. The empirical cases illustrate how difficult it is to provide support in such a complex and large organisation as the hospital where heterogeneous actor have various responsibilities, and unexpected contingencies arise.

8. Concluding Remarks

This thesis has presented a research project on the development and implementation of the Electronic Patient Record (EPR) at Rikshospitalet, in Norway.
As mentioned in the introduction, lately there has been an increasing focus on EPRs due to the fact that they are seen as "magic bullets" that are expected to solve the various problems that are faced in the health care organisation. However, as was illustrated in this study, the EPR meets only some of these high expectations. The EPR enhance the way information is gathered, stored, distributed and used. Among others, the EPR increases continuous obtainability to updated information, allows several people to read the same information simultaneously, acquire a better organisation and structure standardized presentation of information, and so forth.
However, in general the implementation process of the EPR turned out to be an unexpectedly long and complex process and many goals have not been met yet.

Drawing upon the empirical cases, no dramatic changes within organisation or effectiveness could be identified. Changes within simple information handling and actions can be found, but the overall routines around patient information handling and the work process are approximately as before. We have also seen how the transition to electronic patient records solved some of the previous problem, but it also introduced new situations and challenges that did not exist before the transition. The empirical material illustrates how the use of the EPR is fragmentary and inefficient compared to the potential. For instance, additional feature such as electronic internal referral letters, electronic prescriptions and sick-leave forms were used by few physicians. Moreover, the existing information infrastructure of the patient record is hybrid and fragmented, and both the paper-based and the electronic records are being used simultaneously.

Therefore, in this study, I addressed the issue of how to manage a gradual transition strategy in such a large and complex organisation. My overall aim was to develop a deeper understanding of the socio-technical aspect of the complexities and challenges that are accumulated in the transition to electronic patient record. I have thereby proposed a theoretical framework based on Actor Network Theory (ANT) which I used as a methodological theory to view Information Infrastructures (IIs). In addition, I used theoretical concepts from studies undertaken within the Computer-Supported Cooperative Work (CSCW). Four cases were presented in the empirical material, and there were analysed by merging the information infrastructure perspective together with work practice orientation. From the analysis it emerged that the medical record and the work practice are not singular elements, but rather part of a large heterogeneous socio-technical network that is constituted of artefacts, tools, people, and so forth. Drawing upon the theoretical framework, I focus on the heritage of the installed base, as well as the heritage of the situated work practices which I also view as installed base. The description of the hybrid and fragmented infrastructure sheds light on the need for strategies to manage gradual transitions. One way to do that is to think in term of system cultivation, rather than system construction. In addition to allowing the infrastructure and work practices to dynamically evolve, gateways can be developed in order to link incompatible components. By merging this perspective together with a work practice orientation, I illustrate how the transition process to an EPR is mutual, dynamic and reflexive process

where both the infrastructure and work practices evolve. Thereby, I explore how the heterogeneous actors, the complex medical practice, and the various artefacts are interlinked and aligned to each other, and illustrate how a transformation of one of these components will affect the socio-technical infrastructure. This again sheds light on the importance of finding a way to conduct changes while avoiding breakdown in the whole chain of work. In addition to cultivation and the use of gateways, I suggest to acknowledge the importance of identify borderline resources, as these disappears in the transition process to electronic records. These issues provide us an understanding of the roles and the *use* aspect of technology in practice. Beside the theoretical implications, the case of the EPR provides an opportunity to study the issues of scaling large information infrastructure, and thereby provide an empirical contribution to studies within the Information System (IS) field. Finally, I reflect upon several practical implications for organisation of change in such a large and complex healthcare organisation.

Due to the scope of this study, the empirical material in this research was based upon fieldwork that was conducted merely in two departments, in one hospital.
The infrastructure in RH is tremendously large and complex, which accumulates several issues and aspects that were not taken into account due to the scope of this research. By this I refer to for instance: political issues, economical investments, organisational aspects and so forth. The research study was framed by qualitative research methods following an ethnographic approach. This method has its specific strength in helping to understand people as well as social and cultural phenomena. However, one of the main weaknesses of ethnographic research is that it is tremendously time consuming, as it takes a long time to conduct the fieldwork, and a longer time to write and analyse the empirical material.

At the current stage, the EPR generated a transformation momentum, but due to its complexity it is difficult to anticipate the future of the EPR. Obviously, the development process of EPR will continue, however, Rikshospitalet is still at the beginning of the road, and many changes are still to come. It remains to see whether the aim of having a paper-less hospital within the year 2006 will be accomplished. In the meanwhile, it is vital to study the socio-technical changes that are accumulated in the transition to EPRs. Moreover, I believe that there is a need to explore the impact that these changes have on the complex and dynamic interplay that exists between the existing information infrastructure and the situated work practices.

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Appendix A. – Secrecy statement

Rikshospitalet

Taushetserklæring for Rikshospitalet

Erklæringen gjelder alle som gjennom sitt arbeid ved Rikshospitalet har tilgang til medisinsk informasjon. Erklæringen omfatter således også personer med tilgang til slik informasjon, selv om de formelt ikke er ansatt ved Rikshospitalet.

Navn: Nina Baulus Født: 30.08.78

Firma/avd.: UIO, Institute for Informatikk (IFI)

Stilling: Master Student

Jeg er kjent med at jeg i medhold av helsetjenestelovgivningen har taushetsplikt, og at taushetsplikten gjelder uansett på hvilken måte jeg får kjennskap til noens personlige forhold. Jeg er også kjent med at taushetsplikten gjelder overfor kolleger og medarbeidere, unntatt i den utstrekning som er nødvendig av hensyn til undersøkelse og behandling av pasienten.

Jeg er kjent med at brudd på taushetsplikten eller medvirkning til dette, kan straffes med bøter eller fengsel eller begge deler.

Jeg har satt meg inn i de bestemmelser som er gjengitt på baksiden av denne erklæring og de veiledninger som der er gitt.

Aktuelle bestemmelser:
Min profesjonslovs taushetspliktbestemmelse
Lov om leger § 31, § 34 og § 45
Straffeloven § 121 og § 144
Lov om personregistre mm. § 9 og § 11
Forvaltningsloven § 13

Jeg er kjent med at taushetsplikten også gjelder etter at jeg har sluttet på Rikshospitalet.

"Jeg forplikter meg med dette å bevare taushet om noens personlige forhold som jeg får kjennskap til gjennom mitt arbeide på Rikshospitalet. Jeg er enig i at brudd på taushetsplikt kan betraktes som et vesentlig brudd på gjeldende arbeidsavtale."

Oslo, den 11/10-02 .....
underskrift

For ansatte på Rikshospitalet oppbevares erklæringen av personalavdelingen. For andre oppbevares den av avdelingsoverlegen eller sjeflegen.

Side 1 av 2

Rev. 3/17.07.00

Appendix B. – List of the Fieldwork

Interviews- Passive participation	
11-10-02	Archive Leader
14-10-02	Chief Secretary, Neurosurgery
14-10-02	Doctor, Neurosurgery
15-10-02	Consulent, IT department
23-10-02	Patient Coordinator, Neurosurgery
Oct-2002	Head Nurse, Neurosurgery- Adult unit 1
Interviews	
• ***The Neurology department: [4 physicians, 2 nurses, 4 secretaries]***	
30-10-02	Chief Assistant for the Nurses, Neurology
29-01-03	Secretary (super user and user contact), Neurology
29-01-03	Head of department, Neurology
29-01-03	Nurse, Neurology
06-02-03	Head Office, Neurology
11-01-03	Secretary & Patient Coordinator, Neurology.
07-05-03	Secretary & Patient Coordinator, Neurology-Part 2
16-05-03	Assistant Doctor, Neurology
22-05-03	Assistant Doctor, Neurology
31-10-03	Assistant Doctor, Neurology-Part 2
• ***The Neurosurgery department: [2 physicians, 4 nurses]***	
06-03-03	Patient Coordinators, Neurosurgery
07-03-03	Nurse, Neurosurgery- Adult post 2
13-05-03	Assistant Doctor, Neurology & Neurosurgery
13-05-03	Head Nurse, Neurosurgery- Adult post 2
21-06-03	Surgeon, Head Doctor, Neurosurgery
30-10-03	Patient Coordinator, Neurosurgery-Part 2
• ***Others***	
13-11-02	Training Program Coordinator, ITA
12-11-02	EPR Team (PhD student), IFI
06-05-03	Patient A- Epilepsy case
Observations (39 hours)	
15-10-02	Neurology- Secretaries (1st day using DL)- 30 min
29-10-02	Neurology- Nurses (1st day using DL- 4.5 hours
11-11-02	Orthopedic department- Secretaries (5th day using DL)- 30 min.
13-11-02	Orthopedic department- Nurses- 30 min
28-01-03	Neurology- Nurses & doctors (on-duty room, 3 month using DL)-3h
29-01-03	Neurology- Nurses & doctors(on-duty room, nr.of conversations)5.5h
06-02-03	Neurology- Secretaries (expedition, after 3 month using DL)- 30 min
11-01-03	Neurology- Secretaries (expedition, secretary for 15 min)- 30 min
12-05-03	Neurosurgery- Nurses (Ward- Adult unit1)- 3.5 hours
12-05-03	Neurosurgery- Secretaries (expedition, Adult unit1)- 3.5 hours
13-05-03	Neurosurgery- Secretaries (exp.) & Nurses (Ward- Adult unit1)- 4 h.
16-05-03	Neurology- Pre visit meeting for the doctors- 2 hours

22-05-03	Neurology- Pre visit meeting (First day using elect. ref. letters)- 2h
26-05-03	Neurosurgery- Shadowing a team-leader nurse (Adult unit 1)- 8.30 h
DocuLive user courses (18.5 hours)	
14-10-02	Neurology department- Secretaries (5.5 hours)
16-10-02	Neurology department- Nurses (5.5 hours)
31-10-02	Orthopedic department- Doctors (2.5 hours)
21-01-03	Super User Course- Secretaries (3 hours)
23-01-03	Super User Course- Nurses (2 hours)

Appendix C. – Template of key issues for the fieldwork (Feb. 2003)

The electronic patient record- DocuLive EPR

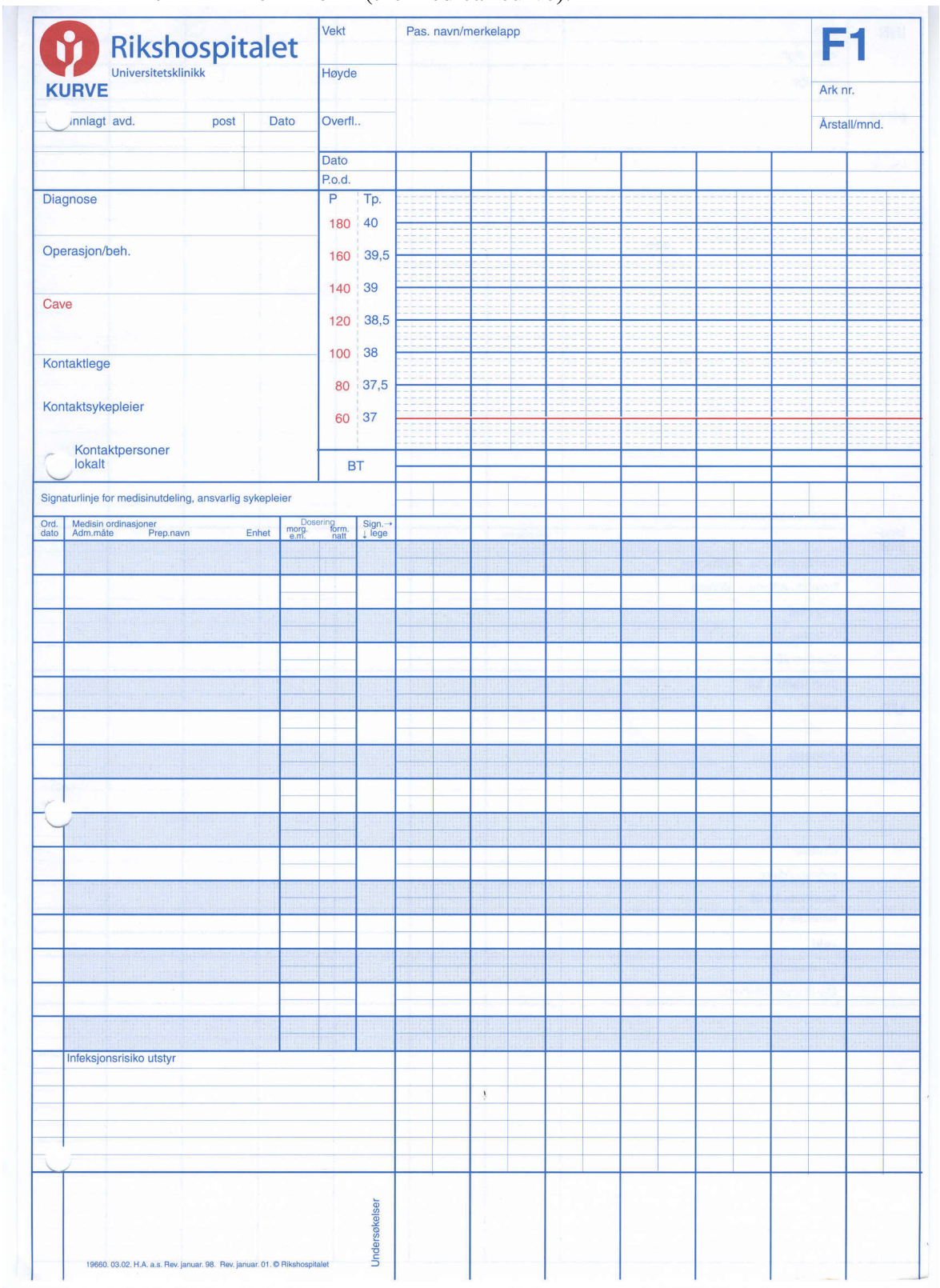
- **The use of the system:**
- How often do you use DocuLive EPR?
- How are you using the EPR system? Why are you using it this way?
- How do you know that you should use it this way? (Were you told by instructors? Did you discovered on your own? Or were you told by colleagues in the next desk?)
- When do you use the paper-based record and when do you use DocuLive?
- Does the EPR system lack any functions? (E.g. specific chapters from the A- J guidelines that should be added?)
- Do you use additional functions? E.g.: electronic prescriptions and sick leave notes.
- **Changes:**
- Do you do things differently from when you where using paper-records, or is it exactly the same?
- What kinds of changes happen? How these changes came about?
  - Is it a meeting where instructors decided that they should start work differently because it has been possible in other departments?
  - Is it individuals (colleagues) who started to do things differently? And the rest just adapted these changes?
  - Or did they start these changes on their own?
- Did the implementation of DocuLive EPR affected the division of work or the position of some of the occupational groups? If so, how?
- **Learning and discovering:**
- How do secretaries, nurses and doctors exchange and share knowledge? Are the physicians active actors in the process?
- Discovering: Did you use the Help functions or other additional functions?
- Do you know who are the user-contacts and super-users in the department? What is their role and responsibility?
- **Complexities and problems faced:**
- What are the problems and complexities that were faced?
- How were they solved, and by whom? (colleagues? HelpDesk? Etc.)
- **Advantage? / Disadvantage?**
- Do you feel more effective using DocuLive? (e.g. re-using information)
- Do you feel that you are doing a better job?

A case study (Parkinsons case)

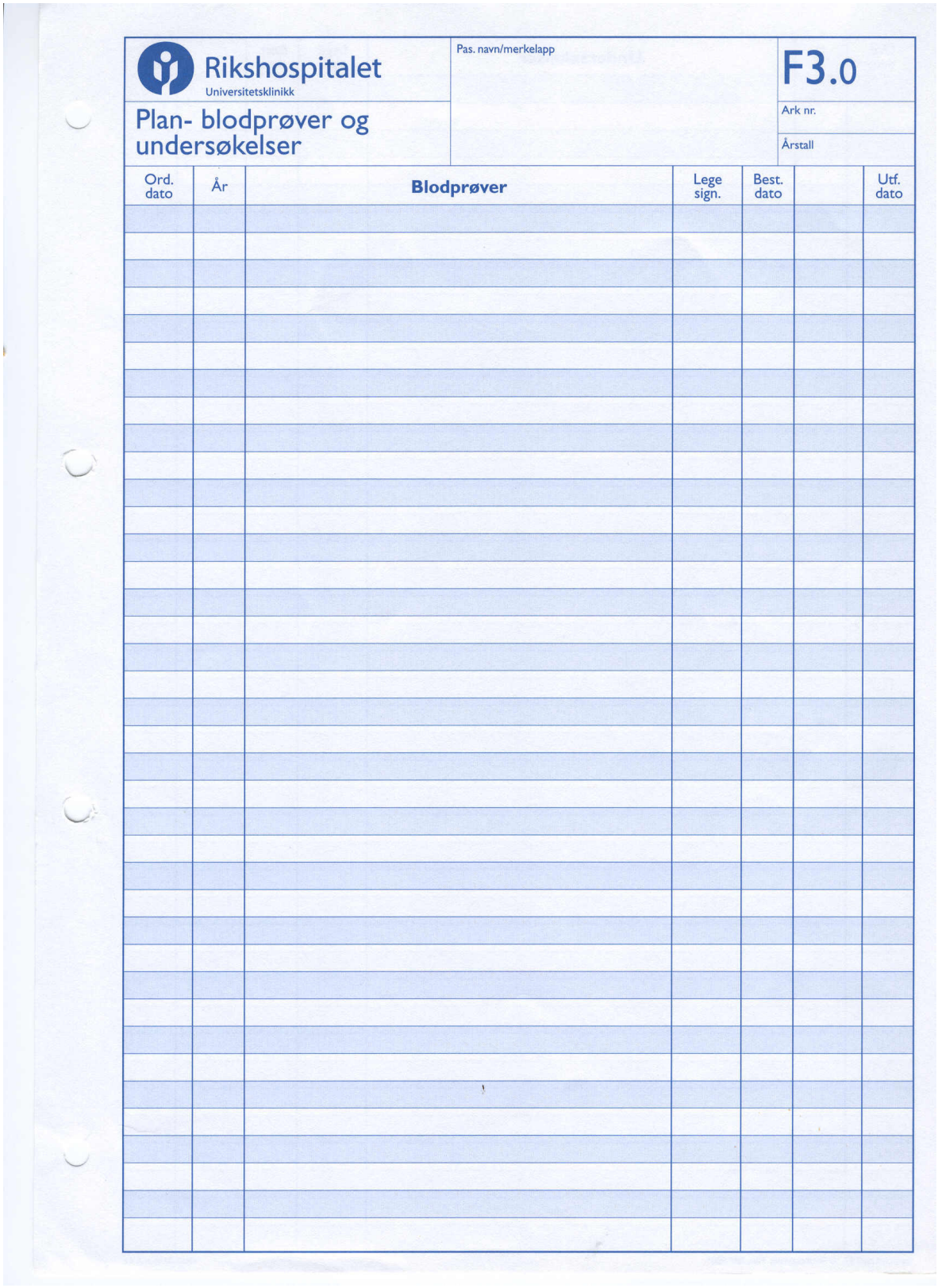
- The information flow: between the occupational groups, the departments, and health care organizations. What kind of information is being registered and where?
- The workflow and division of labour (coordination and cooperation).
- Active participants in the various sub-cases (admission, operation, discharge, control, etc.). Who decides what?
- Movement and circulation of the paper-record and other forms.
- In which cases is DocuLive being used, and in which cases is the paper record being used?

Appendix D. – Forms used in Rikshospitalet

- **D 1. -** The F1 form (the medical-curve):



- **D. 2. -** The F3 form: Plan- examinations, and blood test (front side):



Rikshospitalet
Universitetsklinikk

Pas. navn/merkelapp

F3.0

Ark nr.

Årstall

Plan- blodprøver og undersøkelser

Ord. dato	År	Blodprøver	Lege sign.	Best. dato		Utf. dato

- **D. 3. -** The F3 form: Plan- examinations, and blood test (backside):

Ord. dato	År	Undersøkelser	Lege sign.	Best. dato		Utf. dato

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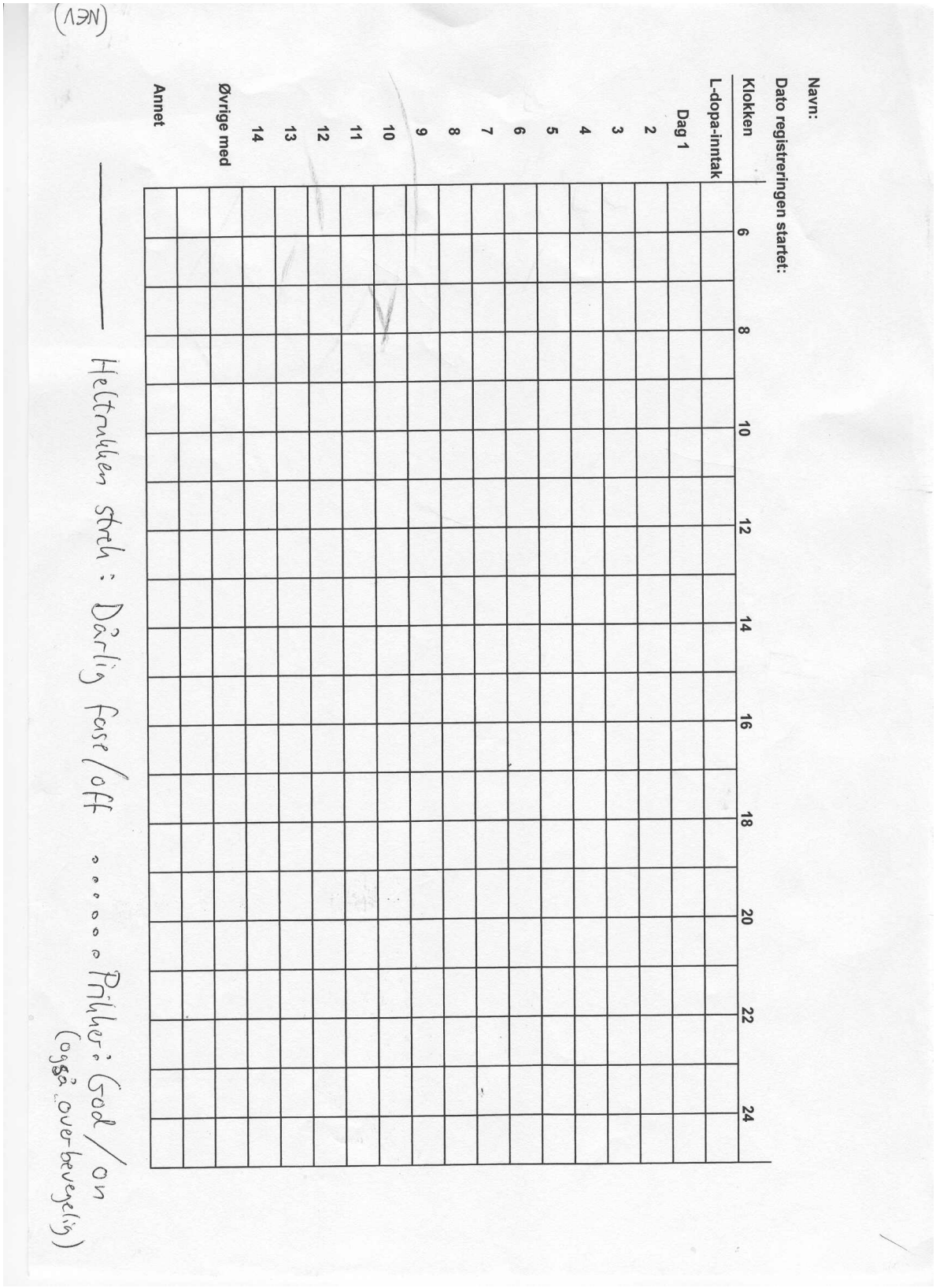
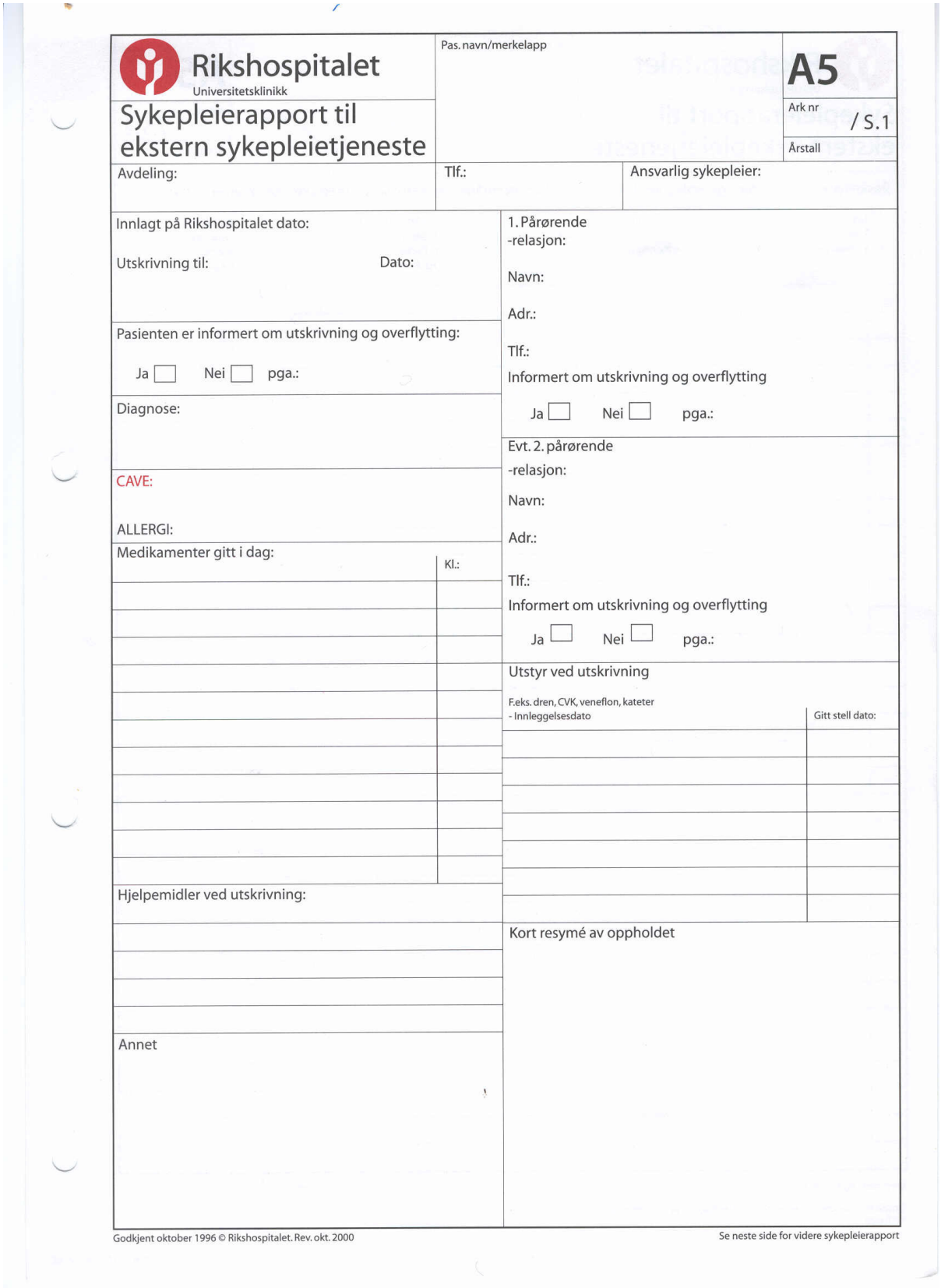
19657. 03.01. H.A. a.s

- **D. 4. -** Parkinsons form:



- **D. 5. -** The A5 form: Nursing discharge summary (front side):



Rikshospitalet
Universitetsklinikk

Sykepleierapport til ekstern sykepleietjeneste

Pas. navn/merkelapp

A5

Ark nr / S.1

Årstall

Avdeling:

Tlf.:

Ansvarlig sykepleier:

Innlagt på Rikshospitalet dato:

Utskrivning til: Dato:

Pasienten er informert om utskrivning og overflytting:

Ja ☐ Nei ☐ pga.:

Diagnose:

CAVE:

ALLERGI:

Medikamenter gitt i dag:

Kl.:

Hjelpemidler ved utskrivning:

Annet

1. Pårørende -relasjon:

Navn:

Adr.:

Tlf.:

Informert om utskrivning og overflytting

Ja ☐ Nei ☐ pga.:

Evt. 2. pårørende -relasjon:

Navn:

Adr.:

Tlf.:

Informert om utskrivning og overflytting

Ja ☐ Nei ☐ pga.:

Utstyr ved utskrivning

F.eks. dren, CVK, veneflon, kateter - Innleggelsesdato

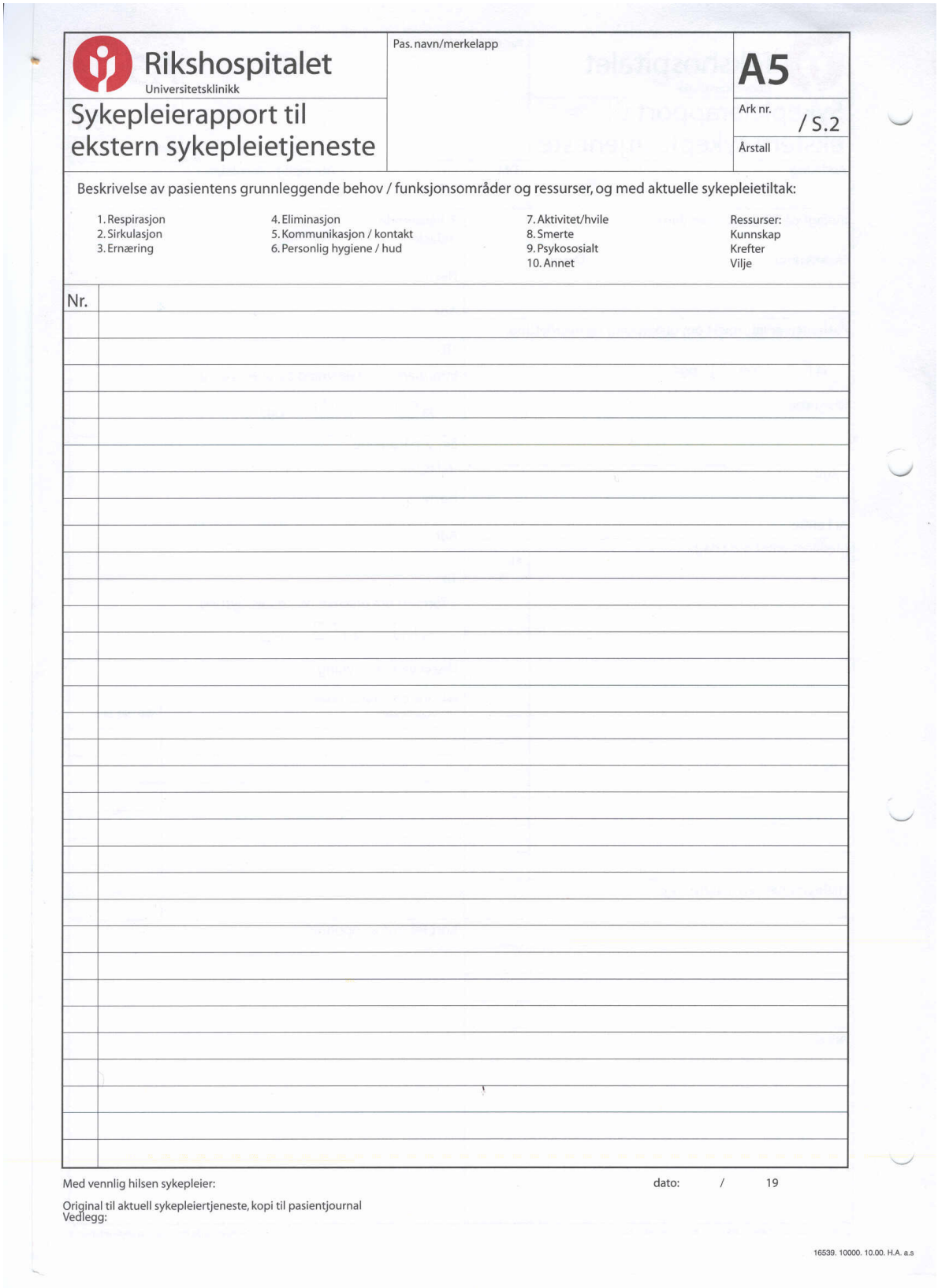
Gitt stell dato:

Kort resymé av oppholdet

Godkjent oktober 1996 © Rikshospitalet. Rev. okt. 2000

Se neste side for videre sykepleierapport

- **D. 6. -** The A5 form: Nursing discharge summary (backside):



Rikshospitalet
Universitetsklinikk

Pas. navn/merkelapp

A5

Ark nr. / S.2

Årstall

Sykepleierapport til ekstern sykepleietjeneste

Beskrivelse av pasientens grunnleggende behov / funksjonsområder og ressurser, og med aktuelle sykepleietiltak:

1. Respirasjon
2. Sirkulasjon
3. Ernæring
4. Eliminasjon
5. Kommunikasjon / kontakt
6. Personlig hygiene / hud
7. Aktivitet/hvile
8. Smerte
9. Psykososialt
10. Annet

Ressurser:
Kunnskap
Krefter
Vilje

Nr.	

Med vennlig hilsen sykepleier: dato: / 19

Original til aktuell sykepleiertjeneste, kopi til pasientjournal
Vedlegg:

16539. 10000. 10.00. H.A. a.s